639036

SAFETY COMPLIANCE TESTING FOR FMVSS 121

Air Brake Systems

Vehicle: MY 2008 Volvo VNM64T (6X4) Tractor
Conventional "Daycab" Body
Volvo Trucks North America
Report #: 121V-TRC-06-008
NHTSA #: C80700
TRC Inc. Test #: 20040769/7006

Transportation Research Center Inc.
P. O. Box B-67
East Liberty, Ohio 43319-0367

August 2007

Final Report

U.S. Department of Transportation

National Highway Traffic Safety Administration

Enforcement

Office of Vehicle Safety Compliance

West Building, W45-117

1200 New Jersey Avenue, S.E.

Washington, D.C. 20590

NOTICE

Transportation Research Center Inc. does not endorse or certify products of manufacturers. The manufacturer's name appears solely to identify the test article. Transportation Research Center Inc. assumes no liability for the report or use thereof. It is responsible for the facts and the accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

Prepared By:

Randall A. Landes, Project Technician
Durability and Dynamics Engineering

Approved By:

Jeff Sankey, Manager, Project Operations
Durability and Dynamics Engineering

1. REPORT NUMBER:	2. GOVERNMENT ACCESSION NO.:	3. RECIPIENTS CATALOG NO.:
121V-TRC-06-008		

4. TITLE AND SUBTITLE:	5. REPORT DATE:
Final report of FMVSS 121 Compliance Testing of a 2008 Volvo VNM64T (6X4) Tractor, NHTSA No. C85900	August 14, 2007
	6. PERFORMING ORGANIZATION CODE: TRC 20040769/7006
7. AUTHOR(S): Project Manager: RANDALL A. LANDES	8. PERFORMING ORGANIZATION REPORT NO.: 121V-TRC-06-008
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Transportation Research Center Inc. 10820 State Route 347 East Liberty, Ohio 43319	10. WORK UNIT NUMBER:
	11. CONTRACT OR GRANT NO.: DTNH22-05-C-01006
12. SPONSORING AGENCY NAME AND ADDRESS: U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance West Building, W45-117 1200 New Jersey Ave., S.E. Washington, DC 20590	13. TYPE OF REPORT AND PERIOD COVERED: Final test report Tested: 06/11/07 to 07/26/07
	14. SPONSORING AGENCY CODE: NVS-220

15. SUPPLEMENTARY NOTES:

16. ABSTRACT:

Compliance tests were conducted on the subject 2008 Volvo VNM64T (6X4) Tractor, NHTSA No. C80700, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-121V-05, for the determination of FMVSS 121 compliance.
Test failures identified were as follows:

None.

17. KEY WORDS:	18. DISTRIBUTION STATEMENT:
Compliance Testing Safety Engineering FMVSS 121	Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services (NPO-411) 1200 New Jersey Ave. S.E., Room W45-212 Washington, DC 20590 Email: tis@nhtsa.dot.gov FAX: 202-493-2833

19. SECURITY CLASSIF. (OF THIS REPORT):	20. SECURITY CLASSIF. (OF THIS PAGE).	21. NO. OF PAGES: 85	22. PRICE:
Unclassified	Unclassified		

Table of Contents

Section	Description	Page
1.0	Purpose of Compliance Test	1
2.0	Vehicle Information	4
3.0	Test Data Summary	6
4.0	Test Data	8
5.0	Instrumentation List	31
Appendix A	Photographs	
Appendix B	Test Data from Report Generator	
Appendix C	Engineer's Comments	

List of Tables/Data Sheets

No.	Title	Page
Test Data Summary		
1.	Summary of Data for Laboratory Test "Application & Release Times"	7
2.	Data Summary of the Stopping Distances	7
Test Data		
3.	Vehicle Information Sheet - FMVSS 121	9
4.	Verification of Required Equipment	13
Laboratory Tests		
5.	Brake Actuation and Release Times	14
Road Tests		
6.	Park Brake Chamber Actuation Pressure	15
10.	Burnish	16
11.	Stability and Control @ GVWR	19
11a.	Stability and Control @ LLVW	20
12.	Service Brake Stopping Test @ GVWR	21
16.	Park Brake Test, 20% Grade Holding – GVWR	22
17.	Parking Brake Test Drawbar Pull – GVWR	23
18.	Service Brake Stopping Test @ LLVW	24
19.	Emergency Brake Stopping Test - Primary Reservoir Failure @ LLVW	25
20.	Emergency Brake Stopping Test - Secondary Reservoir Failure @ LLVW	26
21.	Emergency Brake Stopping Test - Primary Control Line Failure @ LLVW	27
22.	Park Brake Test, 20% Grade Holding – LLVW	28
23.	Final Inspection	29

LIST OF PHOTOGRAPHS

Figure	Photograph Title
1.	Front View @ GVWR
2.	Right Side View @ GVWR
3.	Left Side View @ GVWR
4.	Rear View @ GVWR
5.	Front View @ LLVW
6.	Right Side View @ LLVW
7.	Left Side View @ LLVW
8.	Rear View @ LLVW
9.	Manufacturer's Placard
10.	Manufacturer's Vehicle Specification Placard
11.	Wet/Supply (left), Secondary (center) and Primary (right) Reservoirs
12.	Left Front/Steer Brake Assembly
13.	Left Front/Steer Brake Chamber
14.	Left Front/Steer Brake Slack Adjuster
15.	Left Front/Steer Brake Thermocouple Installation
16.	Left Front/Steer Brake Wheel Speed Sensor
17.	Left Front/Steer Brake ABS Modulator and Quick Release Valves
18.	Right Intermediate Brake Assembly
19.	Right Intermediate Brake Chamber
20.	Right Intermediate Brake Slack Adjuster
21.	Right Intermediate Brake Thermocouple Installation
22.	Right Rear Brake Assembly
23.	Right Rear Brake Chamber
24.	Right Rear Brake Slack Adjuster
25.	Right Rear Brake Thermocouple Installation
26.	Right Rear Brake Wheel Speed Sensor
27.	Rear Brake ABS Modulator Valves and R12 Valve
28.	Rear Brake Quick Release Valve

LIST OF PHOTOGRAPHS, CONTINUED

29. Air Dryer

30. Instrumentation in Vehicle

31. Ballast on Vehicle

32. Ballast in Vehicle

33. Dash Warning Lamps

SECTION 1.0

Purpose of Compliance Test

Purpose

Transportation Research Center Inc. (TRC Inc.) conducted this program for the National Highway Traffic Safety Administration (NHTSA). The purpose of this test was to determine if the subject vehicle, a 2008 Volvo VNM64T (6X4) tractor, meets the performance requirements of FMVSS 121, "Air Brake Systems."

Test Procedure

This test was conducted in accordance with NHTSA's Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure No. TP-121V-05. Data was obtained relative to FMVSS 121, "Air Brake Systems." Deviations from the procedure: the only tests performed under section 10.2 "Laboratory Tests" were 10.2 I. "Brake Actuation and Release Timing." The test sequence was performed as follows:

1. Burnish GVWR
2. Brake Actuation and Release Timing GVWR
3. Stability & Control GVWR
4. Stability & Control LLVW
5. Service Brake Stops GVWR
6. Park Brake – Grade Holding GVWR
7. Static Retardation Force GVWR
8. Service Brake Stops LLVW
9. Emergency Brake (Primary Reservoir Failure) Stops LLVW
10. Emergency Brake (Secondary Reservoir Failure) Stops LLVW
11. Emergency Brake (Primary Control Line Failure) Stops LLVW
12. Park Brake – Grade Holding LLVW
13. Final Inspection

The vehicle information is summarized in Section 2.0. The test data summary is located in Section 3.0, the test data is located in Section 4.0, and the test summary is located in Section 5.0. Appendix A contains the still photographic prints. Appendix B lists the test data in Report Generator format.

SECTION 2.0

Vehicle Information

Vehicle Information

The completed test vehicle is a 2008 Volvo VNM64T (6X4) Tractor with a wheelbase of 158 inches, manufactured by Volvo Trucks North America. The Gross Vehicle Weight Rating (GVWR) is 50,000 pounds and the test vehicle is equipped with a Bendix "K" Series, 4S/4M anti-lock brake system.

SECTION 3.0

Test Data Summary

Test Data Summary

Table 1

Summary of Data for Laboratory Test "Application & Release Times"

Average Times in Seconds	Application Max. Allowable – 0.45			Apply - Not Later Than Fastest Chamber, or < 0.35	Release Max. Allowable – 0.55			Release Max Allow. – 0.75
	Right Steer #1	Right Drive #2	Right Drive #3	50 Cubic Inch Reservoir	Right Steer #1	Right Drive #2	Right Drive #3	50 c.i. Resvr.
Full System Operating	0.297	0.342	0.340	0.273	0.404	0.466	0.456	0.602
ABS Main Power Failed	0.296	0.241	0.340	0.269	0.407	0.476	0.467	0.610
ABS Wheel Sensor Failed (Open)	0.289	0.335	0.332	0.268	0.405	0.463	0.454	0.600
ABS Wheel Sensor Failed (Short)	0.291	0.338	0.336	0.274	0.390	0.456	0.445	0.594

The nominal park brake chamber pressures were 1.4 psi, 3 seconds after control valve actuated.

Table 2

Data Summary of the Stopping Distances

Distance in Feet (Corrected Dist.)	GVWR		LLVW		Maximum Allowable
	Minimum	Maximum	Minimum	Maximum	(ft.)
1.2 Service Brakes	278.0	304.7	197.6	207.7	GVWR – 355 LLVW – 335
Failed Primary Reservoir	N/A	N/A	195.4	204.6	GVWR – N/A LLVW – 720
Failed Secondary Reservoir	N/A	N/A	275.3	287.4	GVWR – N/A LLVW – 720
Failed Primary Control Line	N/A	N/A	233.4	267.4	GVWR – N/A LLVW – 720

The vehicle passed the Stability and Control tests.

SECTION 4.0

Test Data

TEST DATA
TABLE 3
VEHICLE INFORMATION SHEET - FMVSS 121

Vehicle: 2008 Volvo VNM64T (6x4) Tractor Veh. Number: C80700 [redacted]

Test No.: 20040769/7006 Test Date(s): 06/11/2007 to 07/26/07

Test Facility/Location: TRC/Transportation Research Center Inc., East Liberty, Ohio

Truck/Tractor Year, Make, and Model: 2008 Volvo VNM64T, 6X4, Conventional "Daycab" Tractor

Build Date: January 2007 VIN: 4V4MC9GF58N488369

Body No.: 488369 Chassis No.: No Data

GVWR: 50,000 lbs. GAWRs: 12,000 lbs. – Steer; 38,000 lbs. – Drives (total)

Engine Data: Type: (Diesel, gas, other) Diesel
6 Cylinders (Inline) _____ Cu. In. 12.1 Liter 365 HP

Transmission: 10 Speed X Manual _____ Automatic _____ O.D.

Axle Drive Configuration: 6X4 Center of Gravity - Tractor (in): 53 (Estimated)

Initial Odometer: 79 mi.

Wheelbase: Truck, (in): 158 Control Trailer, (in): 262

Retarder(s) Type(s): One-Engine (Vovlo) Aerodynamic Treatments: Yes ___ No X

BRAKES:

	Type[1]	Size	Make	Lining (Edge Code)
Axles:				
Steer #1	Cam	15 x 4 in.	Meritor	R301 FF
Drive #2	Cam	16.5 x 7 in.	Meritor	MA212 FF
Drive #3	Cam	16.5 x 7 in.	Meritor	MA212 FF

[1] Cam, disc, wedge, etc.

....Continued

BRAKE DRUM/ROTOR:

	Type[2]	Make	Dust Shields Installed?
Axles:			
Steer #1	Cast Drum	Gunite	No
Drive #2	Cast Drum	Gunite	No
Drive #3	Cast Drum	Gunite	No

[2] Cast or composite drum, vented or non-vented rotor, etc.

ACTUATION DETAILS:

	AIR CHAMBERS		SLACK ADJUSTERS		
	Make	Type[3]	Length or Wedge angle	Mfr.	Cam Rotation[4]
Axles:					
Steer #1	Haldex	20	5.5 in.	Haldex	Same
Drive #2	Haldex	30/30	5.5 in.	Haldex	Same
Drive #3	Haldex	30	5.5 in.	Haldex	Same

[3] Size and diaphragm or piston
[4] Same or opposite to forward wheel rotation

TIRES

	Pressure (psi)	Size	Make	Model	Static Loaded Radius Measured*	Databook (Website)
Axles:						
Steer #1	105 psi	11R22.5	Bridgestone	R287	20.2 in.	19.2 in.
Drive #2	105 psi	11R22.5	Bridgestone	M726 EL	20.5 in.	19.6 in.
Drive #3	105 psi	11R22.5	Bridgestone	M726 EL	20.6 in.	19.6 in.

*Measured at test GVWR.
REMARKS: There were dual tires at each wheel end on the rear drive axles, only.

....Continued

ABS:

Mfr: Bendix "K" Model: No Data Configuration: 4S/4M

FRONT SUSPENSION:

Type: Solid Axle/Taper Leaf Spring Make: ArvinMeritor Model: FF961NX389

INTERMEDIATE (TAG) SUSPENSION:

Type: Solid Axle/Air Ride Make: ArvinMeritor Model: RD20145NFN3967 390

REAR SUSPENSION:

Type: Solid Axle/Air Ride Make: ArvinMeritor Model: RR20145NFN3967 390

Rear Axle Spread, (in): 52 Overall Width (SAE J693): 97.5 in.

FIFTH WHEEL:

Fifth Wheel Height Relative to Ground (in): 45 Fifth Wheel Position, (in)[5]: 41
Load CG – Control Trailer (in.): 70
[5]Relative to rear axle(s) centerline.

AIR SYSTEM:

Compressor Capacity (cfm): No Data

Cut-out (psi): No Data
Cut-in (psi): No Data

Crack Pressure Ratings (psi)[5]:

1st Axle: No Data 2nd Axle: No Data Treadle Valve[6]: No Data
[5] Relative to rear axle(s) centerline (include sketch if necessary)
[6] Total crack pressures between treadle valve and brake chambers

Front Axle Limiting: No Data

Air Dryer: Bendix AD-IP*

Air Compounding: No Data

Number of Brakes Controlled: Six brake positions ABS controlled, (4S/4M).

*Manufacturer's data.

....Continued

AIR TANK VOLUMES. (cu. in.):

Supply: No Data Primary: No Data Secondary: No Data
Auxiliary: No Data Isolated From Service? No Data

Note: None.

SPECIAL CONDITIONS:

None.

WEIGHTS (lbs):

	Empty	LLVW	Burnish	GVWR	GAWR
Axle: Steer #1	8,940	9,360	11,390	11,910	12,000
Drive #2	3,650	3,720	18,040	20,000	19,000
Drive #3	3,550	3,560	16,550	17,990	19,000
Control Trlr.	0	0	3,980	3,850	NA
Total:	16,140	16,640	49,960	53,750	50,000

REMARKS: Automatic adjustments/compensation regarding the air ride tractor's suspension, made precise vehicle weight adjustments/measurements difficult.
Placard GVWR: 50,000 lbs.

TEST DATA
TABLE 4
VERIFICATION OF REQUIRED EQUIPMENT

Vehicle: 2008 Volvo VNM64T (6X4) Tractor Veh. No.: C80700

Date: 07-24-07 Driver: R. Heberling Technician: R. Landes Odometer: 843 mi.

	YES	NO
SERVICE BRAKES		
All Wheels Equipped with Brakes	X	
All Brakes Equipped with Automatic Brake Adjusters	X	
Brake Adjustment Indicators are visible from a location adjacent to or beneath the vehicle	X	
ANTILOCK BRAKE SYSTEM		
Antilock System Installed	X	
Proper axle control	X	
Comments: None		
Antilock Warning Signal within Drivers Field-of-View Amber letters, black background, no audible warning	X	
SERVICE RESERVOIRS		
No. of Reservoirs 3		
Automatic Condensate drain valve(s) or supply reservoir	X	
Automatic Operation of condensate drain valve		X
Each Reservoir has a Drain Valve which can be manually operated	X	
PARKING BRAKES		
Parking Brake Control Separate from Service Brake Control	X	
Parking Brake Control Accessible from Operator's Seat	X	
Parking Brake control is identified in a manner that specifies its operation	X	

Parking Brake Control Operates Parking Brakes of Towed Vehicle	___N/A	___Yes	X No

REMARKS: None.

LABORATORY TESTS
TABLE 5
BRAKE ACTUATION AND RELEASE TIMES

Vehicle: 2008 Volvo VNM64T (6X4) Tractor Veh. Number: C80700 [redacted]

Date: 07-17-07 Driver: R. Landes Technician: R. Landes

Run No.	Right Steer #1		Right Drive #2		Right Drive #3		50 c.i. Reservoir	
	Apply (sec)	Release (sec)	Apply (sec)	Release (sec)	Apply (sec)	Release (sec)	Apply (sec)	Release (sec)
FULL SYSTEM - ABS MAIN POWER ACTIVE								
1	0.300	0.406	0.345	0.462	0.342	0.451	0.275	0.599
2	0.298	0.412	0.344	0.467	0.341	0.459	0.271	0.603
3	0.294	0.394	0.338	0469	0.336	0.457	0.271	0.603
Avg.	0.297	0.404	0.342	0.466	0.340	0.456	0.273	0.602
FULL SYSTEM - ABS MAIN POWER FAILED								
1	0.286	0.420	0.333	0.483	0.330	0.475	0.260	0.610
2	0.301	0.380	0.346	0.460	0.344	0.451	0.272	0.600
3	0.302	0.422	0.345	0.484	0.346	0.475	0.275	0.620
Avg.	0.296	0.407	0.341	0.476	0.340	0.467	0.269	0.610
ABS - WHEEL SENSOR FAILED – OPEN								
1	0.286	0.403	0.334	0.464	0.331	0.459	0.266	0.602
2	0.286	0.403	0.333	0.456	0.330	0.444	0.266	0.595
3	0.295	0.409	0.338	0.469	0.336	0.459	0.273	0.604
Avg.	0.289	0.405	0.335	0.463	0.332	0.454	0.268	0.600
ABS - WHEEL SENSOR FAILED – SHORT								
1	0.285	0.384	0.335	0.455	0.334	0.444	0.271	0.593
2	0.293	0.395	0.338	0.459	0.336	0.447	0.275	0.593
3	0.294	0.390	0.340	0.445	0.338	0.444	0.277	0.595
Avg.	0.291	0.390	0.338	0.456	0.336	0.445	0.274	0.594

REMARKS: To simulate the "Open" failure and immediately adjacent to the wheel, the left rear drive (axle #3) wheel speed sensor lead was disconnected. To simulate the "Shorted" failure and immediately adjacent to the wheel, the left rear drive (axle #3) wheel speed sensor connector was disconnected and the two receptacle wire ends to the ABS ECU were connected with a wire. For the ABS Active tests, the ignition was in the ON/RUN position with the engine not running. For the ABS Main Power Failed tests, the ignition was in the OFF position. All tests were performed with the vehicle attached to "shop" air and regulated to approximately 100 psi.

ROAD TESTS
TABLE 6
PARK BRAKE CHAMBER ACTUATION PRESSURE

PARKING BRAKE TEST

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

Vehicle Number: C80700 [redacted]

Test Performed By: R. Landes

Date: 07-17-07

PARK BRAKE CHAMBER ACTUATION PRESSURE

AXLE # 2

RUN NUMBER	PRESSURE IN INTERMEDIATE PARKING CHAMBER AFTER 3 SECONDS (PSI)	
	LEFT	RIGHT
1	1.37	1.40
2	1.40	1.40
3	1.38	1.40
AVERAGE	1.38	1.40

If average pressure is less than or equal to 3 psi, use 0 psi

REMARKS: Average time to reach 3 psi – 0.7 sec. for #2. Parking brake chambers only on axle #2.

Note: Tables 7 through 9 are for tests not performed by the laboratory and are, therefore, not included.

ROAD TESTS
TABLE 10
BURNISH

Vehicle: 2008 Volvo VNM64T (6X4) Tractor Vehicle Number: C80700 [redacted]

8.1 BURNISH TEST WEIGHTS: STEER AXLE: 11,390 lbs. DRIVE AXLES: 34,590 lbs. TRAILER: 3,980 lbs.			
Driver No.	**Date**	**Odometer Start**	**Odometer End**
1	07/11/07	84	220
1	07/12/07	222	352
1	07/13/07	352	506
1	07/16/07	508	609

	Date	**Time**	**Odometer**
Test Start	07/11/07	11:30	84
Test Finish	07/16/07	11:45	609

	ADJUSTMENT LEVELS							
	1L	**1R**	**2L**	**2R**	**3L**	**3R**	**4L**	**4R**
Initial	5/8 in.	5/8 in.	5/8 in.	5/8 in.	5/8 in.	5/8 in.	NA	NA
1st	3/8 in.	1/4 in.	1/4 in.	3/8 in.	1/4 in..	5/16 in.	NA	NA
2nd	5/16 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.	NA	NA
3rd	5/16 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.	1/4 in.	NA	NA
Final	1/4 in.	1/4 in.	1/4 in.	516 in.	1/4 in.	1/4 in.	NA	NA

REMARKS: A mechanic adjusted the freestrokes to 5/8 in. measurement. "Freestroke" measurement values were checked and *if* less than 1/2 in., adjusted to 5/8 in. at the required intervals and at brake temperatures below 200 degrees F. All initial Burnish adjustment clearances were set at 5/8 in.
All post-Burnish adjustments set to 5/8 in. freestroke.
Driver #1 – Richard Heberling.

....Continued

Snub #	Initial Speed (mph)	Avg. Cntrl. Press. (psi)	Avg. Decel (ft/s^2)	Initial Brake Temperatures ºF											
				1L	1R	2L	2R	3L	3R						
1	39.2	52.1	8.9	133	152	152	154	139	130						
25	40.7	58.8	7.7	266	299	317	280	300	323						
50	40.6	56.3	8.8	267	361	405	310	370	412						
75	40.3	59.8	9.7	248	339	370	285	358	385						
100	40.8	56.3	9.5	270	366	399	309	384	417						
125	40.6	63.5	10.2	282	379	408	317	395	425						
150	39.8	48.8	10.7	252	296	305	279	320	322						
175	40.1	47.0	10.2	262	333	349	287	353	369						
200	40.2	49.3	10.3	269	345	361	293	362	388						
225	40.1	43.6	10.1	265	318	326	291	342	347						
250	40.4	45.3	10.1	272	340	353	296	363	378						
275	40.5	52.8	9.5	261	308	299	284	324	321						
300	39.8	58.2	10.1	271	340	351	292	364	376						
325	40.3	47.3	8.9	269	319	317	288	340	347						
350	39.9	54.5	10.0	280	349	357	301	371	390						
375	40.4	56.1	10.5	269	316	314	286	339	341						
400	40.4	53.1	10.0	279	324	320	298	348	351						
425	40.1	39.7	9.8	265	318	306	276	338	336						
450	40.3	41.6	10.1	277	349	352	289	374	396						
475	39.7	40.4	10.1	275	346	351	284	378	395						
500	39.8	40.8	10.5	284	357	366	292	392	410						

(Table continued on next page)

REMARKS: #1 = steer axle; #2 = forward or intermediate drive axle; #3 = rear drive axle.

....Continued

Snub #	Initial Target Speed mph	Ambient Temp ºF	Comments	Driver Initials	Time
1	40	74	Initiate.	RH	11:30
25	40	75		RH	
50	40	76		RH	
75	40	77		RH	
100	40	78		RH	
125	40	79	Shift end @ 128.	RH	15:45
150	40	69	Adjustment – begin shift.	RH	10:15
175	40	72		RH	
200	40	73		RH	
225	40	76		RH	
250	40	75	Adjustment – end shift @ 253.	RH	14:15
275	40	66	Begin shift.	RH	9:15
300	40	68		RH	
325	40	71		RH	
350	40	73		RH	
375	40	75	Adjustment.	RH	13:55
400	40	76	End shift @ 400.	RH	15:40
425	40	73	Begin shift	RH	9:35
450	40	73		RH	
475	40	76		RH	
500	40	78	Burnish complete.	RH	11:45

REMARKS: None.

ROAD TESTS
DATA SHEET 11

STABILITY & CONTROL @ GVWR

Vehicle: 2008 Volvo VNM64T (6X4) Tractor Veh. No.: C80700 [redacted]

Initial/End Odo.: 637 / 642

Date: 07-20-07 Driver: R. Heberling Observer/Video: S. Wagoner

Project/Segment Nos.: 20040769/7006 Time: 9:45 - 10:00

Manually Controlled Retarder: NA

Maximum Drive Through Speed 35 mph

75% of Max Drive Through Speed 26.25 mph

STABILITY & CONTROL - GVWR

Stop No.	Initial Speed (mph)	*Apply Time (sec)	Approx. Dist. Out of Lane (ft)	Number Markers Hit	Comments
1	26.3	0.163	0	0	Video Tape
2	26.3	0.185	0	0	Video Tape
3	26.3	0.148	0	0	Video Tape
4	27.2	0.314	0	0	Video Tape

Ambient Temp.: 62°F

Wind Speed: 7 mph

Direction: 338°NW

REMARKS: The vehicle remained in the lane during all four stops.
* See Appendix C.

ROAD TESTS
DATA SHEET 11A

STABILITY & CONTROL @ LLVW

Vehicle: 2008 Volvo VNM64T (6X4) Tractor Veh. No.: C80700

Initial/End Odo.: 644 / 648

Date: 07-20-07 Driver: R. Heberling Observer/Video: S. Wagoner

Project/Segment Nos.: 20040769/7006 Time: 10:35 - 10:55

Manually Controlled Retarder: NA

Maximum Drive Through Speed 38 mph

75% of Max Drive Through Speed 28.50 mph

STABILITY & CONTROL - LLVW

Stop No.	Initial Speed (mph)	*Apply Time (sec)	Approx. Dist. Out of Lane (ft)	Number Markers Hit	Comments
1	28.3	0.125	0	0	Video Tape
2	28.2	0.125	0	0	Video Tape
3	27.2	0.224	0	0	Video Tape
4	28.4	0.167	0	0	Video Tape

Ambient Temp.: 65°F

Wind Speed: 7 mph

Direction: 348°N

REMARKS: The vehicle remained in the lane during all four stops.
* See Appendix C.

DATA SHEET 12
SERVICE BRAKE STOPPING TEST @ GVWR

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted]C80700 Initial/End Odo.: 651 / 669

Date: 07/20/07 Driver: R. Heberling Tech./Video: S. Wagoner

Project/Segment Nos.: 20040769/7006 Time: 12:45 – 13:50

Ambient Temperature: 32° to 100°F. IBTs: 150° to 200°F.

Requirements: Air system fully charged before each stop.
With ABS - fully apply service brake; without - driver modulates control.
Perform stops in neutral or with clutch depressed.
One of the six stops MUST be equal or less than the requirement distance.

Manual brake adjustments permitted prior to performing stops.

Brake Stroke Measurements @ 85 psi (in) "Free" Stroke Measurements (in.)

Axle 1 Left/Right 1 1/2 / 1 3/8 Axle 1 Left/Right 5/16 / 1/4

Axle 2 Left/Right 1 5/8 / 1 3/4 Axle 2 Left/Right 1/4 / 5/16

Axle 3 Left/Right 1 3/4 / 1 3/4 Axle 3 Left/Right 1/4 / 1/4

Dist. Req. (ft.) @ 60: GVW&LLVW Bus: 280; GVW Truck: 310; LLVW Truck & Tractor: 335; GVWR Tractor: 355.

60 MPH SERVICE BRAKE STOPS - GVWR

Stop	Application Pressure (psi)	Initial Speed (mph)	Actual Stopping Distance (feet)	Corrected Stopping Distance per SAE J299	In 12 foot Lane?	Wheel Lock-up Indication Position, Spd. (mph), Time locked (sec.)	Comments
1	117.3	60.2	294.5	292.2	Yes	No	Video Tape
2	109.8	60.1	NA	NA	Yes	No	Video Tape
3	110.8	60.3	308.1	304.7	Yes	No	None
4	133.7	59.8	287.5	289.9	Yes	No	None
5	114.2	60.3	280.6	278.0	Yes	No	None
*6	111.7	20.1	32.5	32.1	Yes	No	Video Tape

Ambient Temp.: 70°F Wind Speed/Dir.: 11 mph, 333°NW

Comments: *Not required – indicant test, only.
Freestrokes were adjusted to 5/8 in. prior to performing service brake stops.
Note: Data Sheets 13, 14 and 15 are not applicable for this vehicle type and are therefore, not included.

ROAD TESTS
DATA SHEET 16
PARK BRAKE TEST
20% GRADE HOLDING - GVWR

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted]C80709 Initial/End Odo.: 748

Date: 07/23/07 Driver: R. Heberling Tech./Video: K. Easterday/R. Landes

Project/Segment Nos.: 20040769/7006 Time: 13:25 - 13:45

Ambient Temperature: 32° to 100°F. IBT's: 150° to 200°F.

Parking Brake Chamber(s) Pressure 0 psi

20% GRADE HOLDING - GVWR

X GVWR LLVW	Initial Brake Temperature(s) (ºF)	Control Pressure to Hold Vehicle (psi)	Movement to Become Stationary on Grade (inches)	Stationary on Grade For 5 minutes	
	Hottest Brake			Yes	No
Up Grade*	172	38	NA		X
Down Grade	166	32	NA		X

Ambient Temp.: 74°F

Wind Speed: 3 mph

Direction: 11°N

REMARKS: The test vehicle did not remain stationary on the grade facing upgrade and downgrade for the required 5-minute period. Therefore, the Static Retardation Force Test was required. Tested at GCVW weight. Both directions were video taped.

ROAD TESTS
TABLE 17
PARKING BRAKE TEST
DRAWBAR PULL – GVWR

Vehicle: 2008 Volvo VNM64T (6X4) Tractor Vehicle Number: C80700 [redacted]

Date: 07-24-06 Driver: R. Heberling Observer/Video: K. Easterday/ R. Landes

Parking Brake Chamber Pressure 0 psi

PEAK FORCE (lbs.) DURING WHEEL ROTATION
Drive Axle (#2)

Brake Temperature Before Forward Pull: 170 °F Before Reverse Pull: 199 °F				
Pull Direction	**0° – 90° Rotation**	**90° – 180° Rotation**	**180° – 270° Rotation**	**270° – 360° Rotation**
FORWARD	9,105	9,047	9,024	9,044
REVERSE	8,433	9,527	*No Data	8,462
Brake Temperature After Forward Pull: 145 °F **After Reverse Pull:** 176 °F				

REMARKS: The parking brake system did not hold the truck stationary while facing both uphill and downhill on the 20% slope. Therefore, the parking brake drawbar pull test (Static Retardation) was then performed. The requirement for the drawbar pull is that the quotient of the peak (Static Retardation) force/GVWR must not be less than 0.14. The minimum peak force required is 7,000 lbs.
*See Appendix C.

DATA SHEET 18
SERVICE BRAKE STOPPING TEST @ LLVW

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted] C8070 Initial/End Odo.: 765 / 776

Date: 7/24/07 Driver: R. Heberling Tech./Video: K. Easterday

Project/Segment Nos.: 20040769/7006 Time: 13:00 – 13:40

Ambient Temperature: 32° to 100°F. IBTs: 150° to 200°F.

Requirements: Air system fully charged before each stop.
With ABS - fully apply service brake; without - driver modulates control.
Perform stops in neutral or with clutch depressed.
One of the six stops MUST be equal or less than the requirement distance.
Manual brake adjustments permitted prior to performing stops.

Brake Stroke Measurements @ 85 psi (in)

Axle 1 Left/Right 1 7/16 / 1 3/8

Axle 2 Left/Right 1 1/2 / 1 5/8

Axle 3 Left/Right 1 9/16 / 1 1/2

"Free" Stroke Measurements (in.)

Axle 1 Left/Right 5/16 / 1/4

Axle 2 Left/Right 1/4 / 1/4

Axle 3 Left/Right 1/4 / 1/4

Dist. Req. (ft.) @ 60: GVW&LLVW Bus: 280; GVW Truck: 310; LLVW Truck & Tractor: 335; GVWR Tractor: 355.

60 MPH SERVICE BRAKE STOPS - LLVW

Stop	Application Pressure (psi)	Initial Speed (mph)	Actual Stopping Distance (feet)	Corrected Stopping Distance per SAE J299	In 12 foot Lane?	Wheel Lock-up Indication Position, Spd. (mph), Time locked (sec.)	Comments
1	117.0	61.2	209.4	201.6	Yes	NO	Video Tape
2	111.5	60.0	207.7	207.7	Yes	NO	Video Tape
3	117.8	59.5	203.0	206.7	Yes	NO	None
4	114.9	59.7	195.7	197.6	Yes	NO	None
5	114.6	59.9	198.9	199.6	Yes	NO	None
6*	109.9	20.1	25.9	25.6	Yes	NO	Video Tape

Ambient Temp.: 72°F Wind Speed/Dir.: 6 mph, 71°E

Comments: *Not required – indicant test, only.

DATA SHEET 19
EMERGENCY BRAKE STOPPING TEST
PRIMARY RESERVOIR FAILURE @ LLVW

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted]C8070 Initial/End Odo.: 776 / 791

Date: 07/24/07 Driver: R. Heberling Tech./Video: K. Easterday

Project/Segment Nos.: 20040769/7006 Time: 13:45 – 14:25

Ambient Temperature: 32° to 100°F. IBTs: 150° to 200°F.

Requirements: Air system fully charged before each stop.
With ABS - fully apply service brake; without - driver modulates control.
Perform stops in neutral or with clutch depressed.
One of the six stops MUST be equal or less than the requirement distance.
Engage service brake between three and five seconds *after* warning displayed.

Dist. Req. (ft.) @ 60 mph: All Vehicles EXCEPT Tractors: 613; Unloaded Tractors: 720.

60 MPH EMERGENCY BRAKE STOPS - LLVW (Primary Reservoir)

Stop	Application Pressure (psi)	Initial Speed (mph)	Actual Stopping Distance (feet)	Corrected Stopping Distance per SAE J299	In 12 foot Lane?	Wheel Lock-up Indication Position, Spd. (mph), Time locked (sec.)	Comments
1	49.2	59.5	192.2	195.4	Yes	NO	Video Tape
2	47.9	60.3	202.8	200.8	Yes	NO	Video Tape
3	48.2	60.5	207.7	204.3	Yes	NO	None
4	47.8	59.0	194.0	201.0	Yes	NO	None
5	48.8	59.9	203.9	204.6	Yes	NO	None
6	46.7	20.0	24.9	25.0	Yes	NO	Video Tape

Ambient Temp.: 73°F Wind Speed/Dir.: 5 mph, 77°E
Comments: *Not required – indicant test, only.

DATA SHEET 20
EMERGENCY BRAKE STOPPING TEST
SECONDARY RESERVOIR FAILURE @ LLVW

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted]C80700 Initial/End Odo.: 791 / 805

Date: 07/24/07 Driver: R. Heberling Tech./Video: K, Easterday

Project/Segment Nos.: 20040769/7006 Time: 14:30 - 14:55

Ambient Temperature: 32° to 100°F. IBTs: 150° to 200°F.

Requirements: Air system fully charged before each stop.
With ABS - fully apply service brake; without - driver modulates control.
Perform stops in neutral or with clutch depressed.
One of the six stops MUST be equal or less than the requirement distance.
Engage service brake between three and five seconds *after* warning displayed.

Dist. Req. (ft.) @ 60 mph: All Vehicles EXCEPT Tractors: 613; Unloaded Tractors: 720.

60 MPH EMERGENCY BRAKE STOPS - LLVW (Secondary Reservoir)

Stop	Application Pressure (psi)	Initial Speed (mph)	Actual Stopping Distance (feet)	Corrected Stopping Distance per SAE J299	In 12-foot Lane?	Wheel Lock-up Indication Position, Spd. (mph), Time locked (sec.)	Comments
1	111.9	60.7	285.8	279.5	Yes	NO	Video Tape
2	109.0	60.0	283.0	282.6	Yes	NO	Video Tape
3	108.9	60.5	280.8	276.0	Yes	NO	None
4	108.8	60.0	287.7	287.4	Yes	NO	None
5	102.1	60.8	282.8	275.3	Yes	NO	None
6*	101.9	19.5	33.1	34.7	Yes	NO	Video Tape

Ambient Temp.: 74°F Wind Speed/Dir.: 2 mph, 55°NW
Comments: *Not required – indicant test, only.

DATA SHEET 21
EMERGENCY BRAKE STOPPING TEST
PRIMARY CONTROL LINE FAILURE @ LLVW

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted] C80700 Initial/End Odo.: 808 / 828

Date: 07/24/07 Driver: R. Heberling Tech./Video: K. Easterday

Project/Segment Nos.: 20040769/7006 Time: 15:50 – 16:35

Ambient Temperature: 32° to 100°F. IBTs: 150° to 200°F.

Requirements: Air system fully charged before each stop.
With ABS - fully apply service brake; without - driver modulates control.
Perform stops in neutral or with clutch depressed.
One of the six stops MUST be equal or less than the requirement distance.
Engage service brake any time after opening solenoid.

Dist. Req. (ft.) @ 60 mph: All Vehicles EXCEPT Tractors: 613; Unloaded Tractors: 720.

60 MPH EMERGENCY BRAKE STOPS - LLVW (Primary Control Line)

Stop	Application Pressure (psi)	Initial Speed (mph)	Actual Stopping Distance (feet)	Corrected Stopping Distance per SAE J299	In 12-foot Lane?	Wheel Lock-up Indication Position, Spd. (mph), Time locked (sec.)	Comments
1	101.0	58.5	242.1	255.0	Yes	NO	Video Tape
2	99.8	59.4	257.8	263.1	Yes	NO	Video Tape
3	101.9	61.6	245.9	233.4	Yes	NO	None
4	96.6	60.6	273.1	267.4	Yes	NO	None
5	99.9	60.0	258.2	258.4	Yes	NO	None
6*	97.2	20.1	32.5	32.2	Yes	NO	Video Tape

Ambient Temp.: 74°F Wind Speed/Dir.: 5 mph, 26°N
Comments: *Not required – indicant test, only.

ROAD TESTS
DATA SHEET 22
PARK BRAKE TEST
20% GRADE HOLDING - LLVW

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted] C80700 Initial/End Odo.: 828 / 828

Date: 07/24/07 Driver: R. Heberling Tech./Video: R. Landes/K. Easterday

Project/Segment Nos.: 20040769/7006 Time: 16:50 – 17:10

Ambient Temperature: 32° to 100°F. IBT's: 150° to 200°F.

Parking Brake Chamber(s) Pressure 0 psi

20% GRADE HOLDING - LLVW

___GVWR _X_LLVW	Initial Brake Temperature(s) (ºF)	Control Pressure to Hold Vehicle (psi)	Movement to Become Stationary on Grade (inches)	Stationary on Grade For 5 minutes	
	Hottest Brake			Yes	No
Up Grade*	187	18	0	X	
Down Grade	172	18	NA		X

Ambient Temp.: 75°F

Wind Speed: 6 mph

Direction: 339°N

REMARKS: The test vehicle remained stationary on the grade facing upgrade for the required five-minute period. For the down grade, the parking brakes were locked; the wheels/tires did not rotate. However, due to very little normal load on the tires and therefore, very little traction, the vehicle "slid" down the hill. Both directions were video taped.

DATA SHEET 23
FINAL INSPECTION

Vehicle: 2008 Volvo VNM64T (6X4) Tractor

TRC Vehicle No.: [redacted] C8700 Final Odo.: 843

Project/Segment Nos.: 20040769/7006 Time: 13:45

Date: 07/25/07 Driver: NA Tech.: R. Landes

Brake Stroke Measurements @ 85 PSI (in.)	"Free-Stroke" Measurements (in.)
Axle 1 Left/Right 1 1/4 / 1 1/8	Axle 1 Left/Right 5/16 / 1/4
Axle 2 Left/Right 1 1/4 / 1 5/16	Axle 2 Left/Right 1/4 / 1/4
Axle 3 Left/Right 1 1/4 / 1 1/4	Axle 3 Left/Right 1/4 / 1/4

SERVICE BRAKES

All Brakes Structurally Intact: **X** Yes No

All Brakes Function Properly: **X** Yes No

All Brakes Adjusted Within Manufacturers Recommendation: **X** Yes No

Overall Condition of Test Vehicle: Good - Used.

Tires replaced: ___Yes _X_No

New Brake Linings: Axle #1 _X_Yes ___No; Axle #2_X_Yes ___No;
Axle #3___Yes ___No; Axle #4___Yes ___No

Additional Comments:
Overall condition of the foundation brakes, post-test, would be described as normal in appearance and color and contact area. No deep fractures or separations were present, though axle #2's linings exhibited some very minor surface fractures. Some glazing was present on all linings. Additionally, the drum's appearance would be described as normal, smooth, moderate polish with light to moderate material transfer and debris.

SECTION 5.0

Instrumentation List

INSTRUMENTATION LIST
INSTRUMENT CALIBRATION (12 MONTH MAXIMUM INTERVAL)

Instrumentation	Serial Number (I.D. No.)	Calibration Date	Next Calibration Date
A-DAT DSR-06 Radar Fifth Wheel	140.00082	Daily on a measured mile	N/A
Lock-Up Detection System	TRC Prop.	Calibrated before test	N/A
Treadle Pressure Transducer	PT-897090	Calibrated before test using a dead weight	N/A
Pressure Transducer	PT-359018	Calibrated before test using a dead weight	N/A
Pressure Transducer	PT-351132	Calibrated before test using a dead weight	N/A
Pressure Transducer	PT-169755	Calibrated before test using a dead weight	N/A
Pressure Transducer	PT-355434	Calibrated before test using a dead weight	N/A
Mansfield-Green Dead Weight Calibrator	DW-6253	04/20/07	04/20/08
Setra Accelerometer	A-167627	Calibrated before test utilizing known calibrated inclines.	N/A
Davis - Ambient Temp. Model 6152	070321N01	03/21/07	03/21/08
Davis – Wind Velocity Model 6140	070321N03	03/21/07	03/21/08
Thermocouples	T52-0B-24K	Calibrated before test	N/A
Toledo Mettler Scales	JXGA-5318823-5KD	06/28/07	09/28/07
McDaniel, Tire Press. Gauge (0-160 psi)	AG-093	05/02/07	08/02/07
LINK System 2060	2101	09/28/06	09/28/07
Toshiba PC (used with LINK)	43366	N/A	N/A

APPENDIX A

PHOTOGRAPHS

Front View @ GVWR

2008 Volvo VNM64T
6x4 Tractor

July 2007

Right Side View @ GVWR

Left Side View @ GVWR

2008 Volvo VNM64T
6x4 Tractor

July 2007

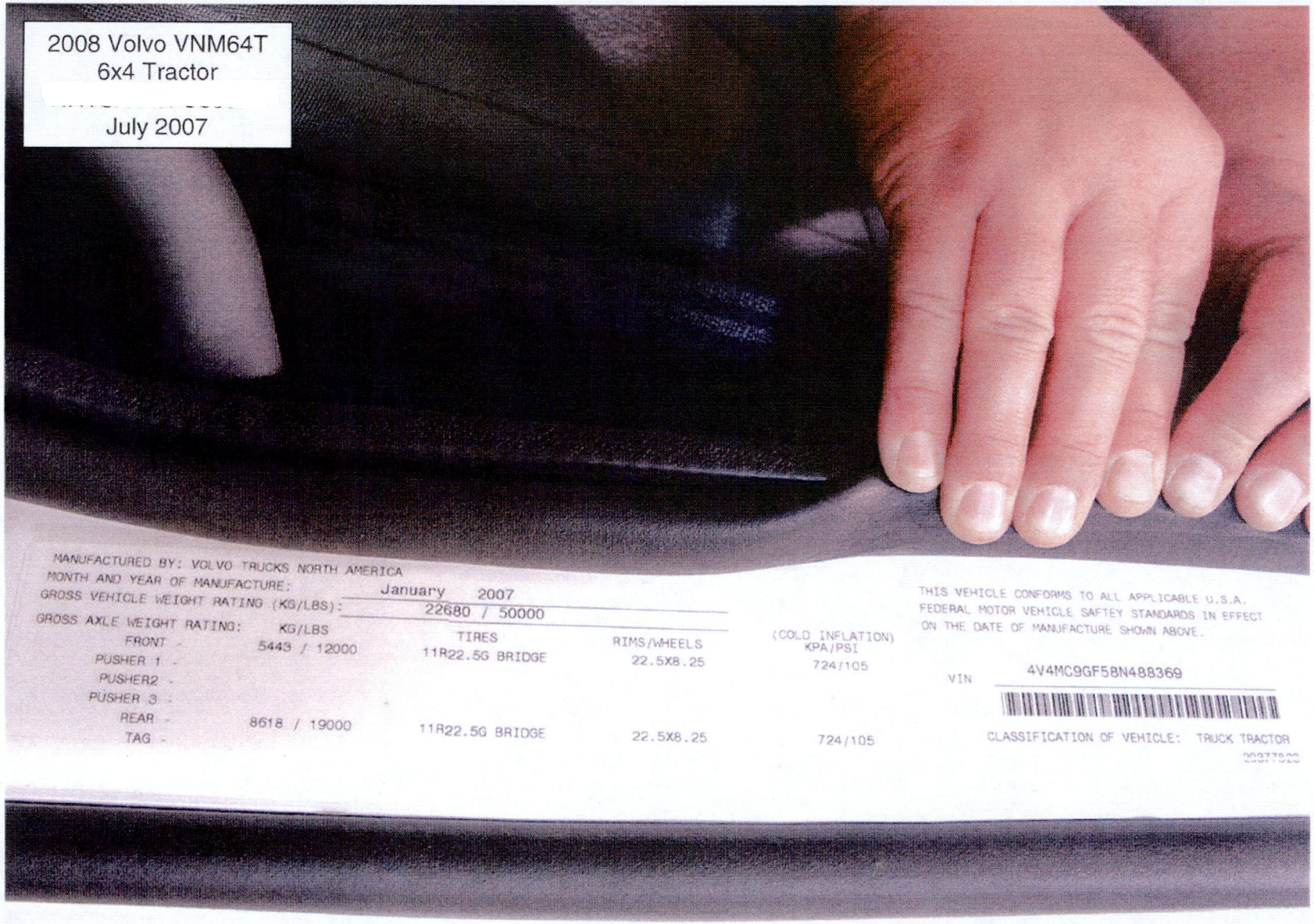
Rear View @ GVWR

Front View @ LLVW

Right Side View @ LLVW

Left Side View @ LLVW

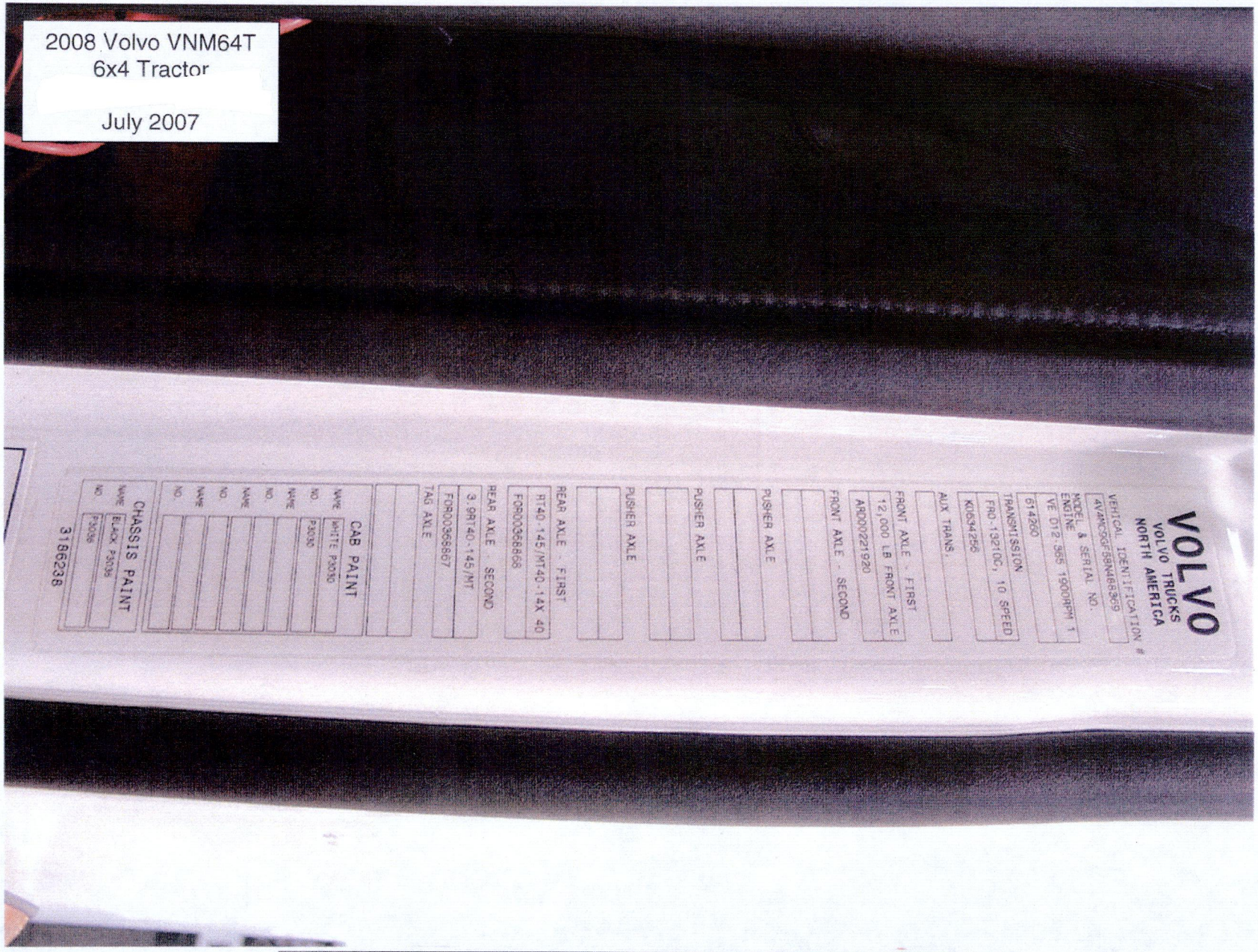
Rear View @ LLVW



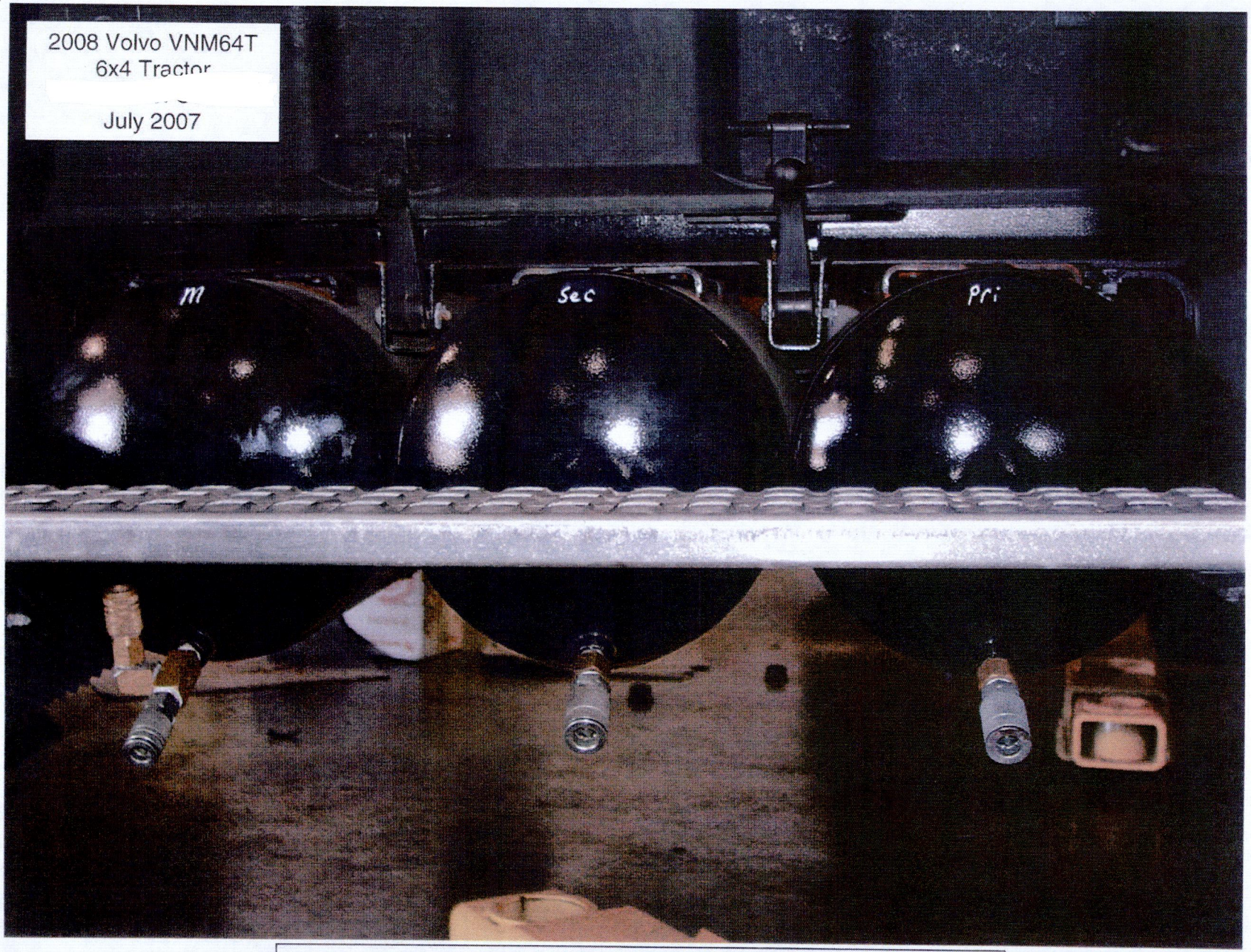
Manufacturer's Placard

2008 Volvo VNM64T
6x4 Tractor

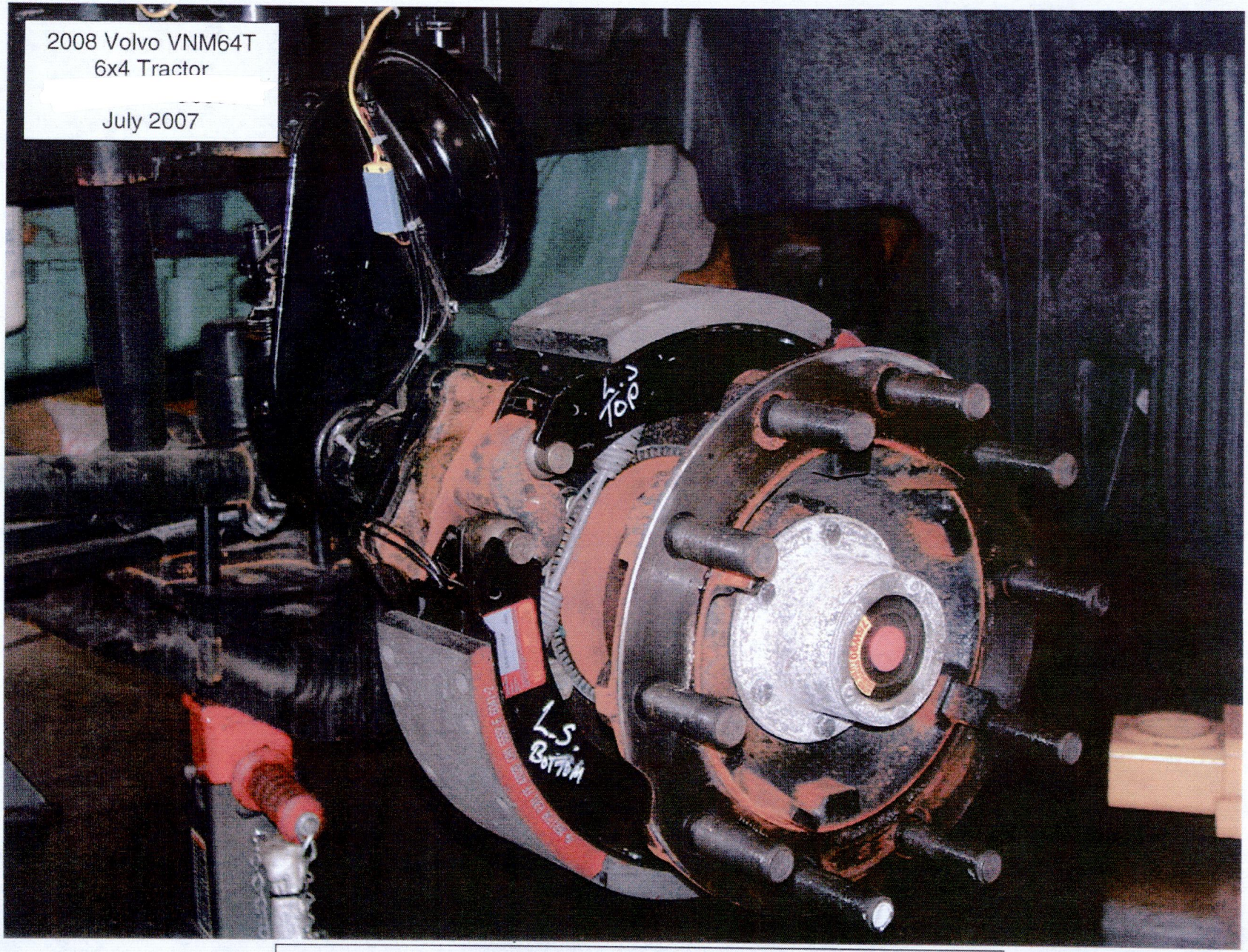
July 2007



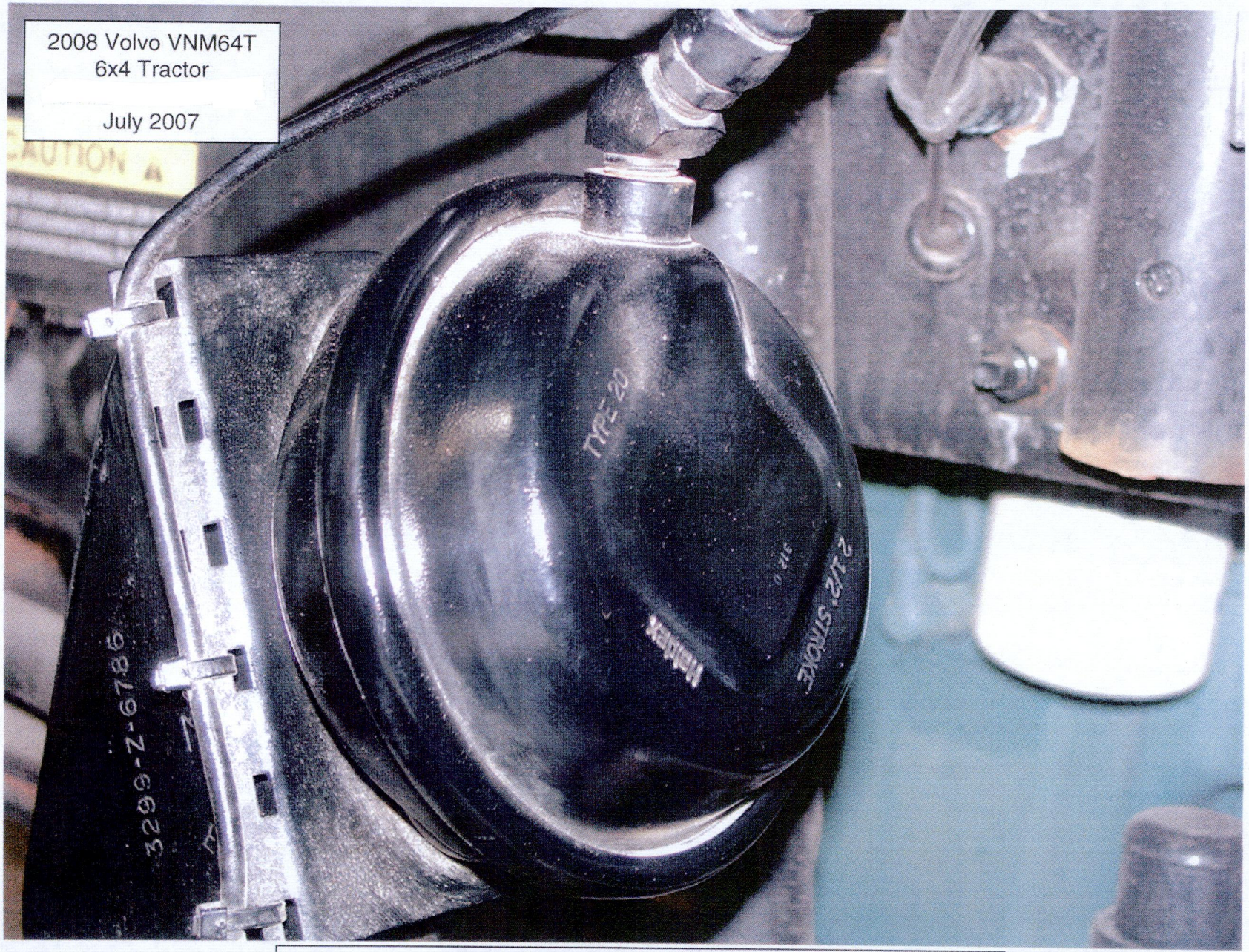
Manufacturer's Vehicle Specification Placard



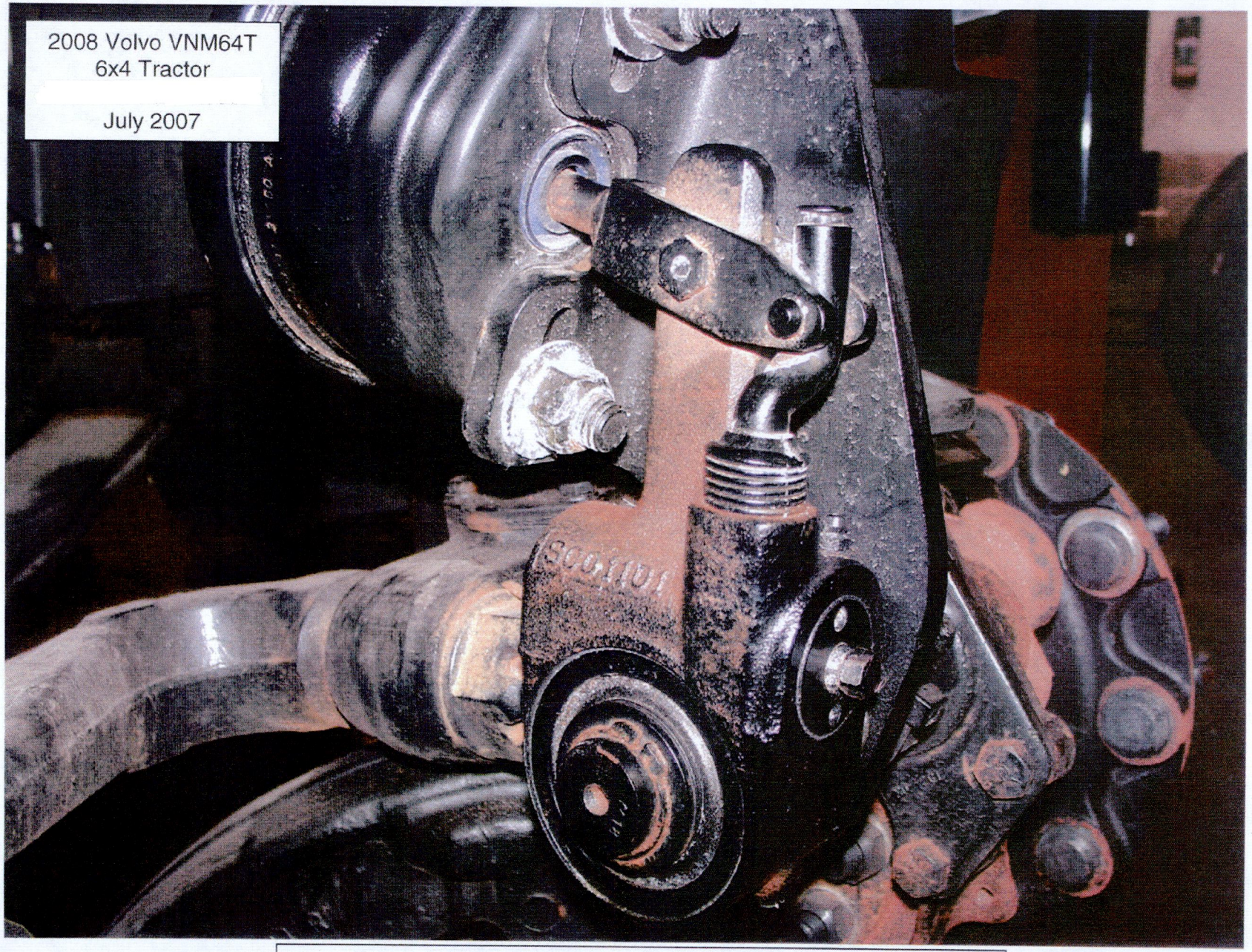
Wet/Supply (left), Secondary (center) and Primary (right) Reservoirs



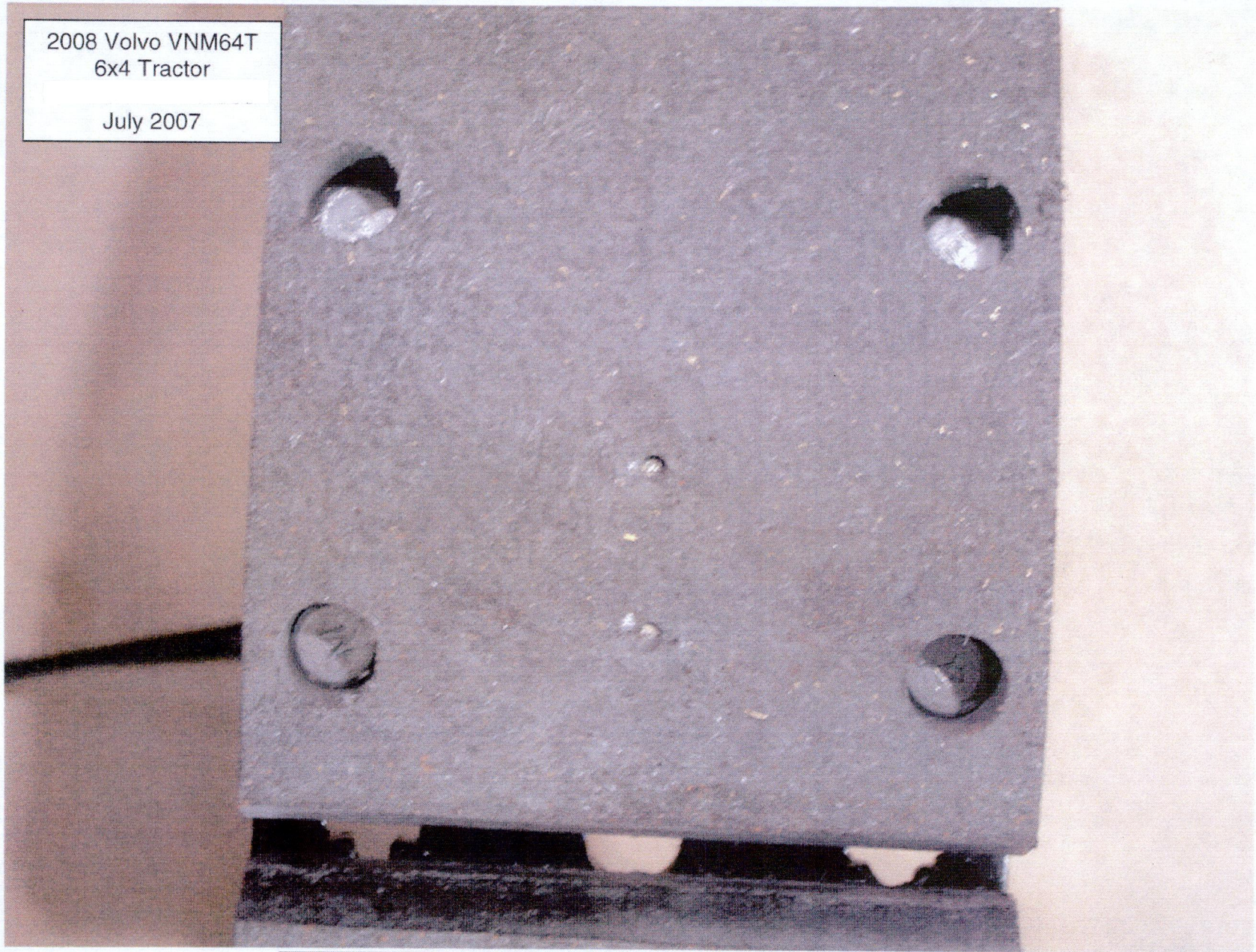
Left Front/Steer Brake Assembly



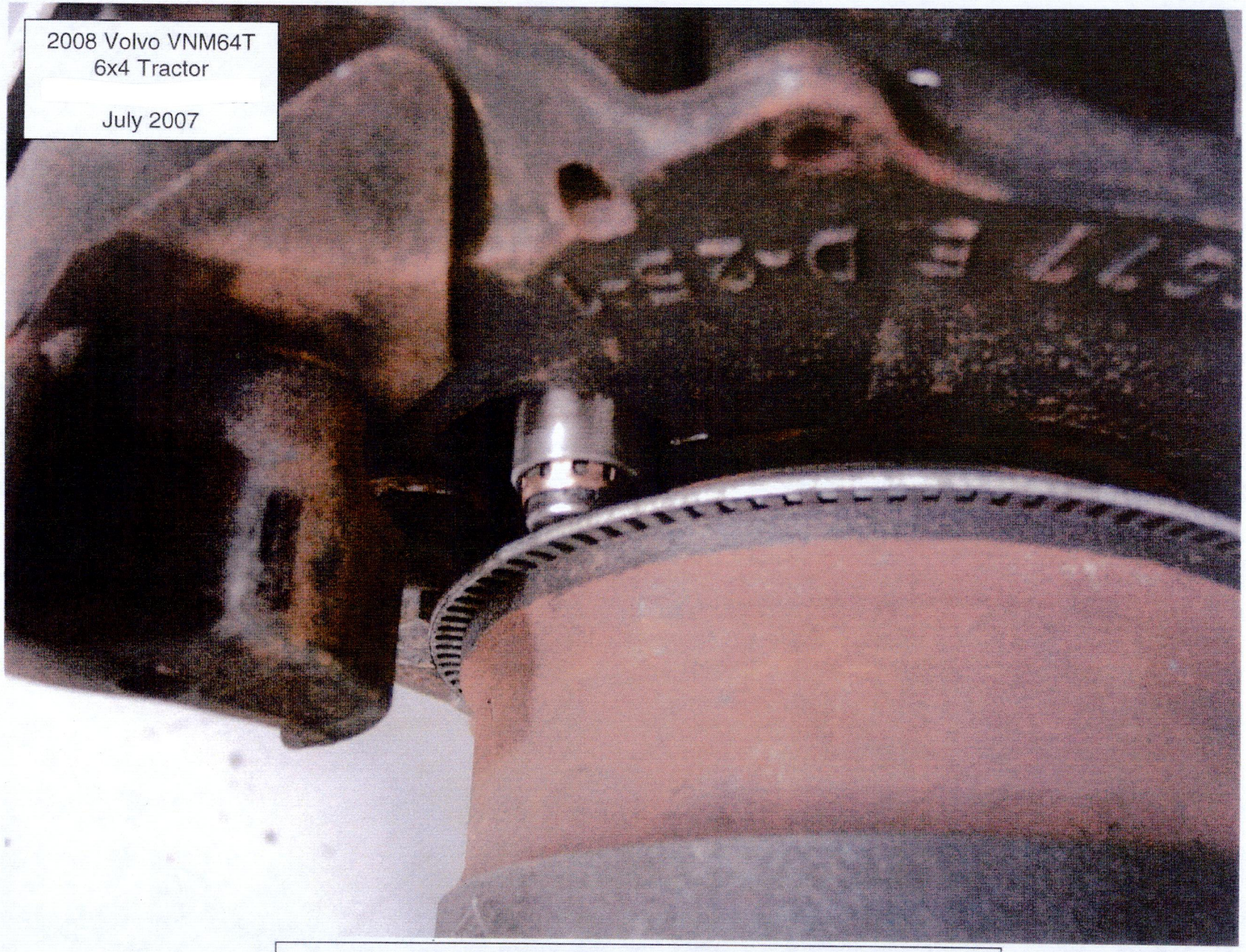
Left Front/Steer Brake Chamber



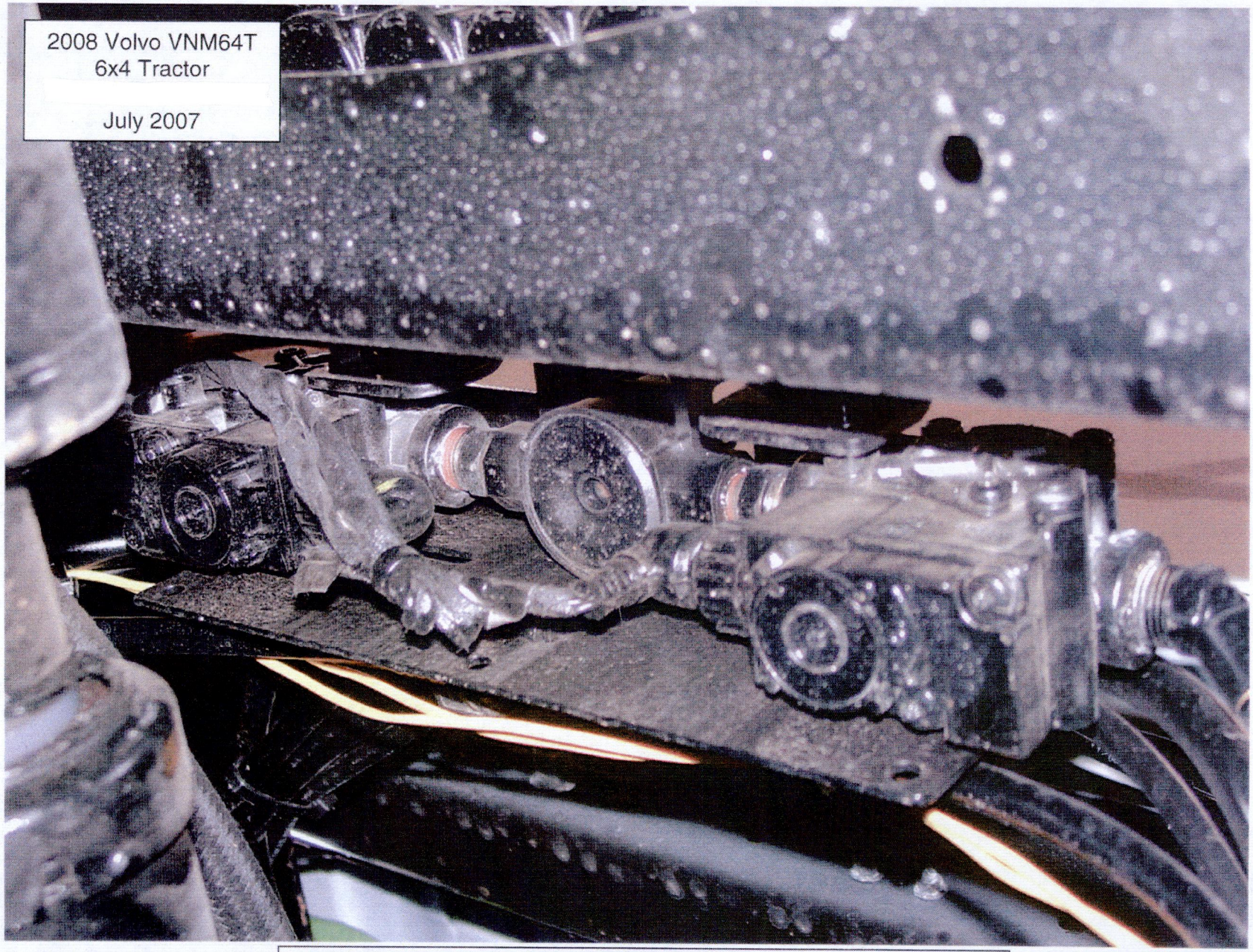
Left Front/Steer Brake Slack Adjuster



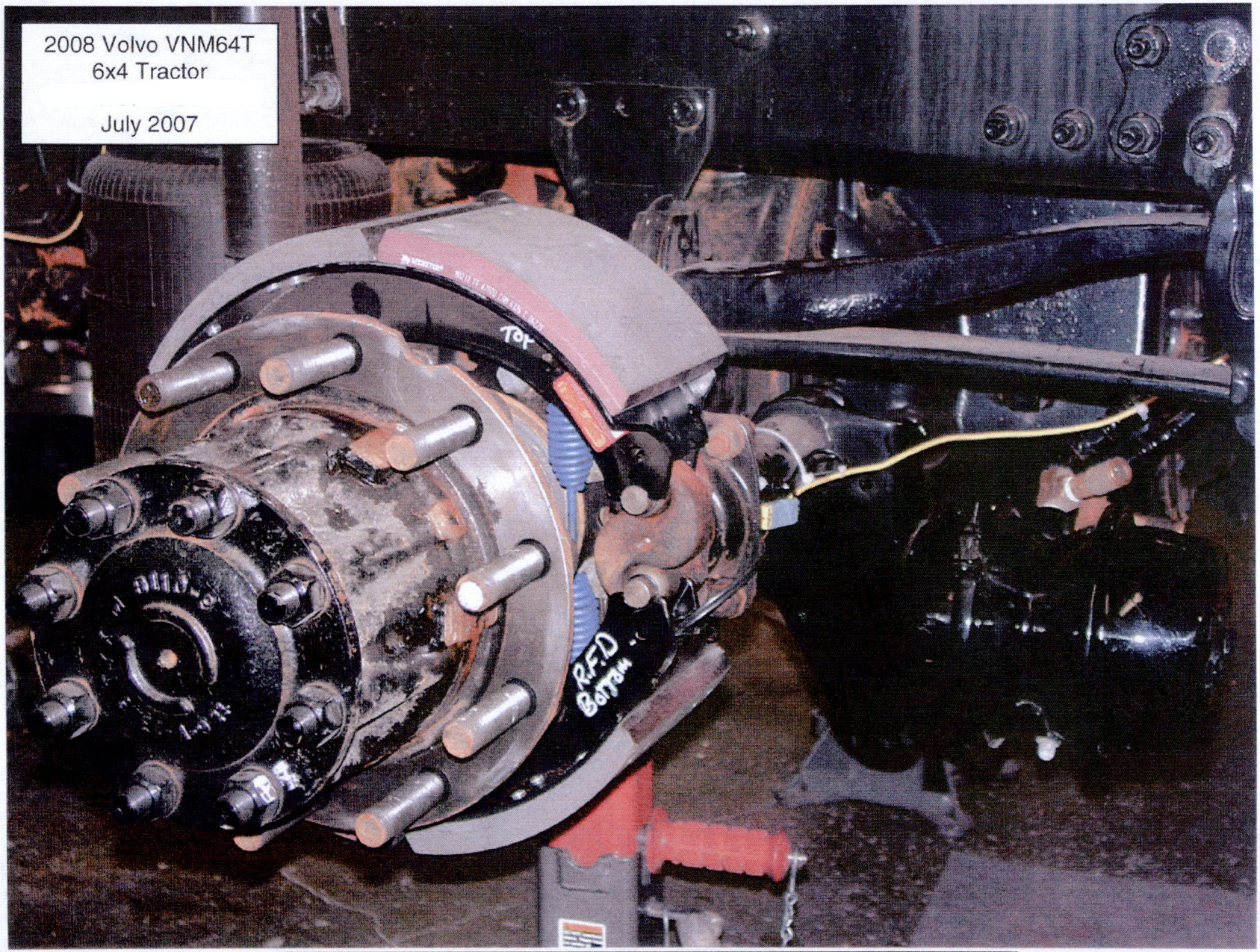
Left Front/Steer Brake Thermocouple Installation



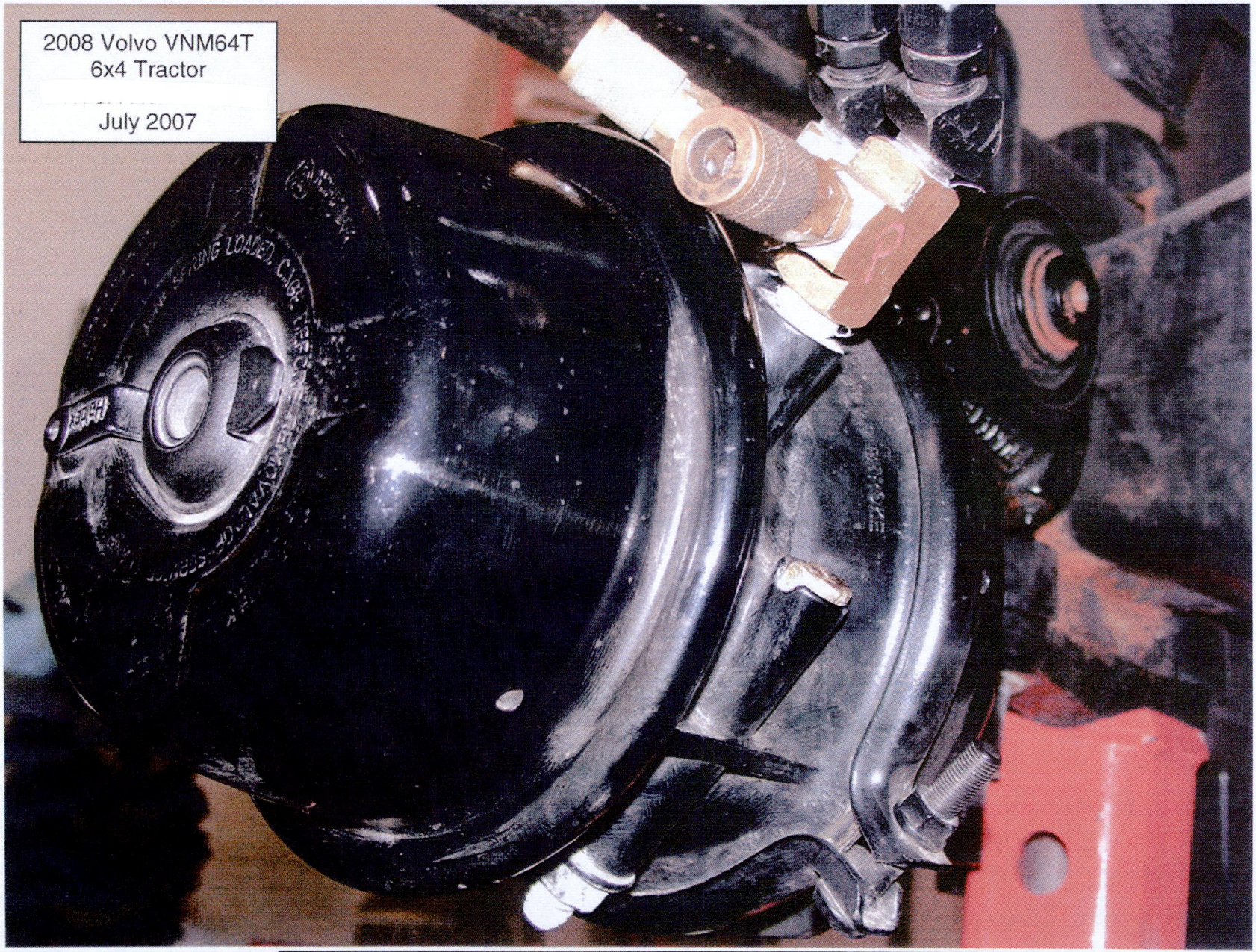
Left Front/Steer Brake Wheel Speed Sensor



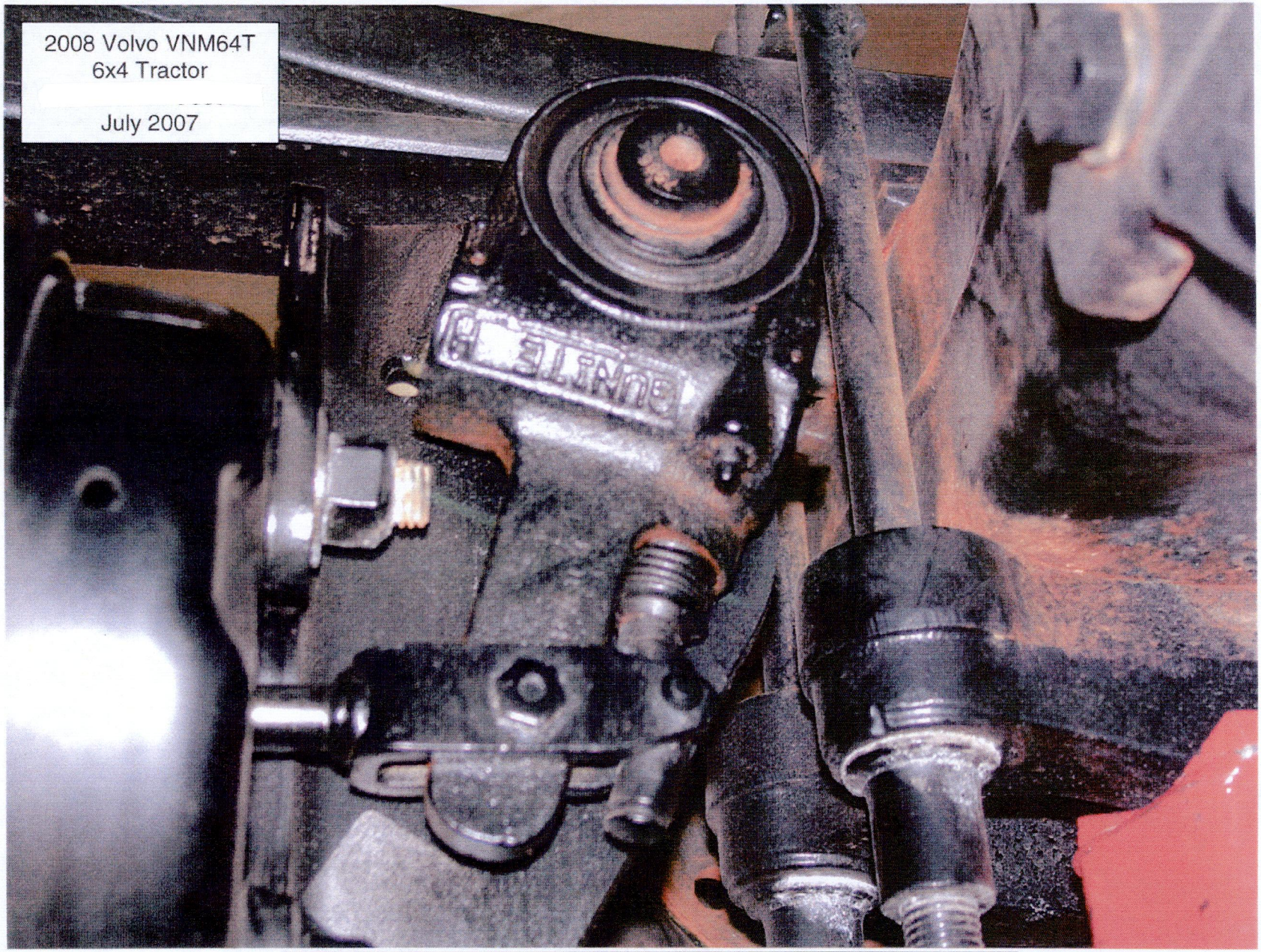
Front/Steer Brake ABS Modulators and Quick Release Valves



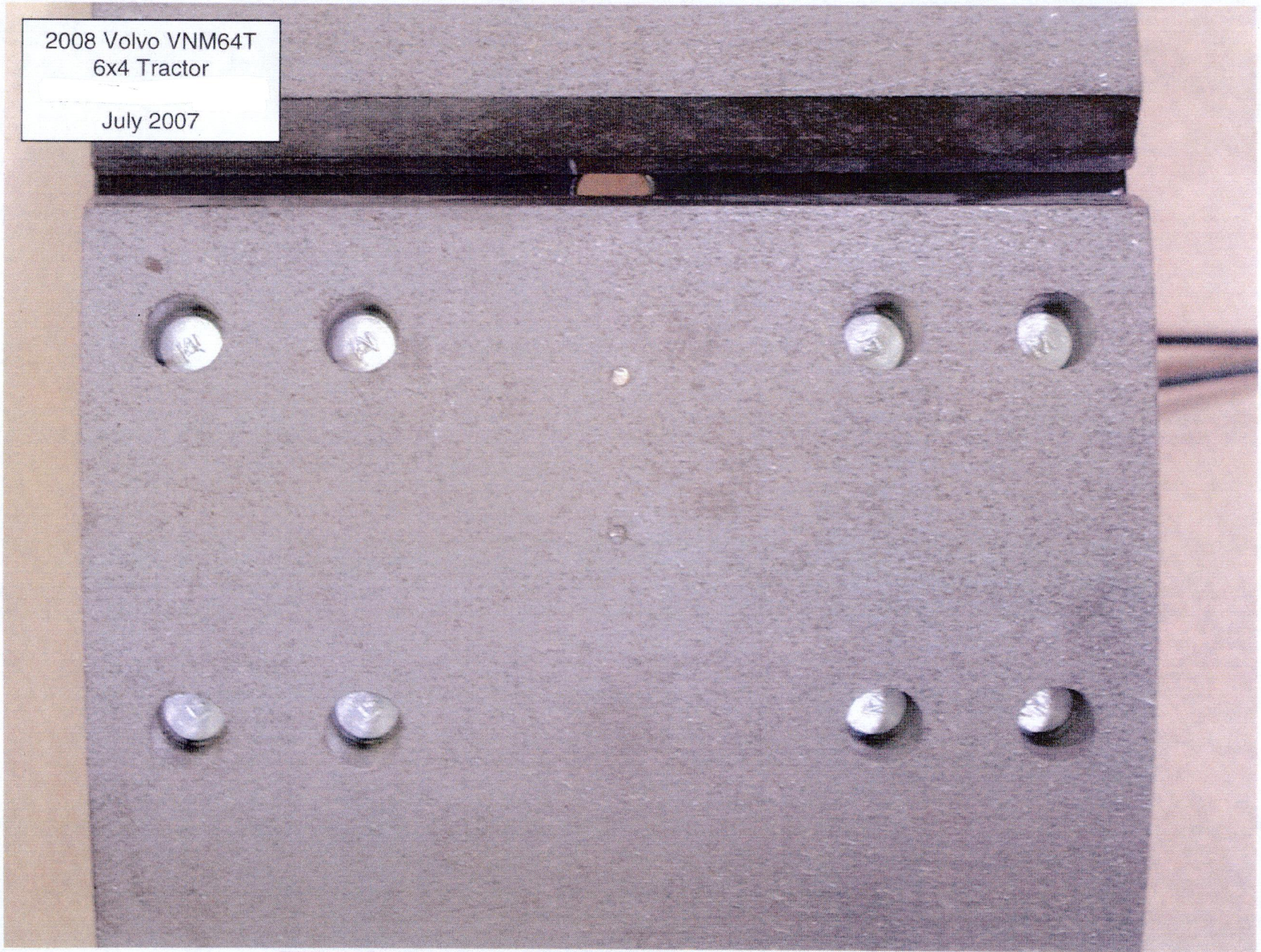
Right Intermediate Brake Assembly



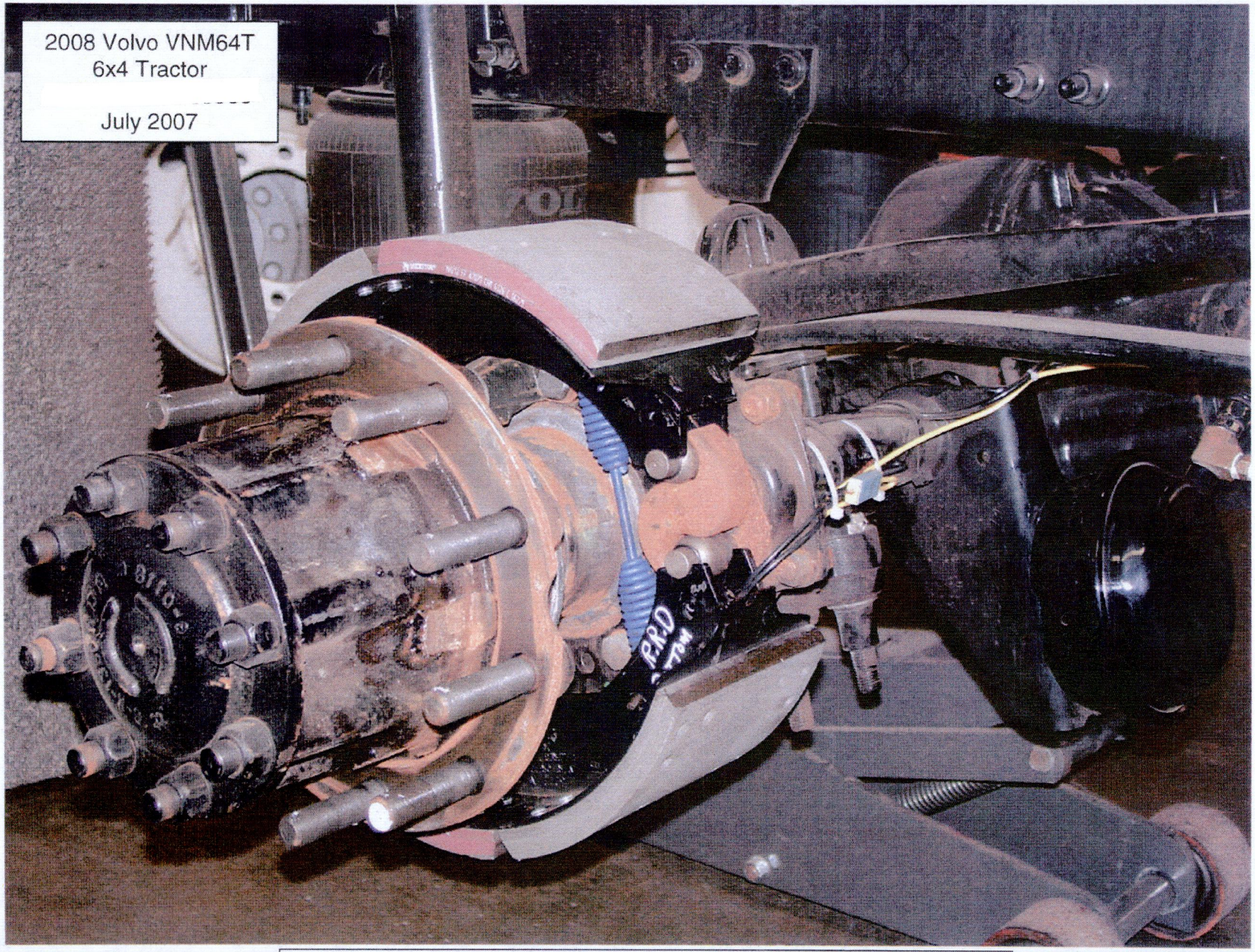
Right Intermediate Brake Chamber



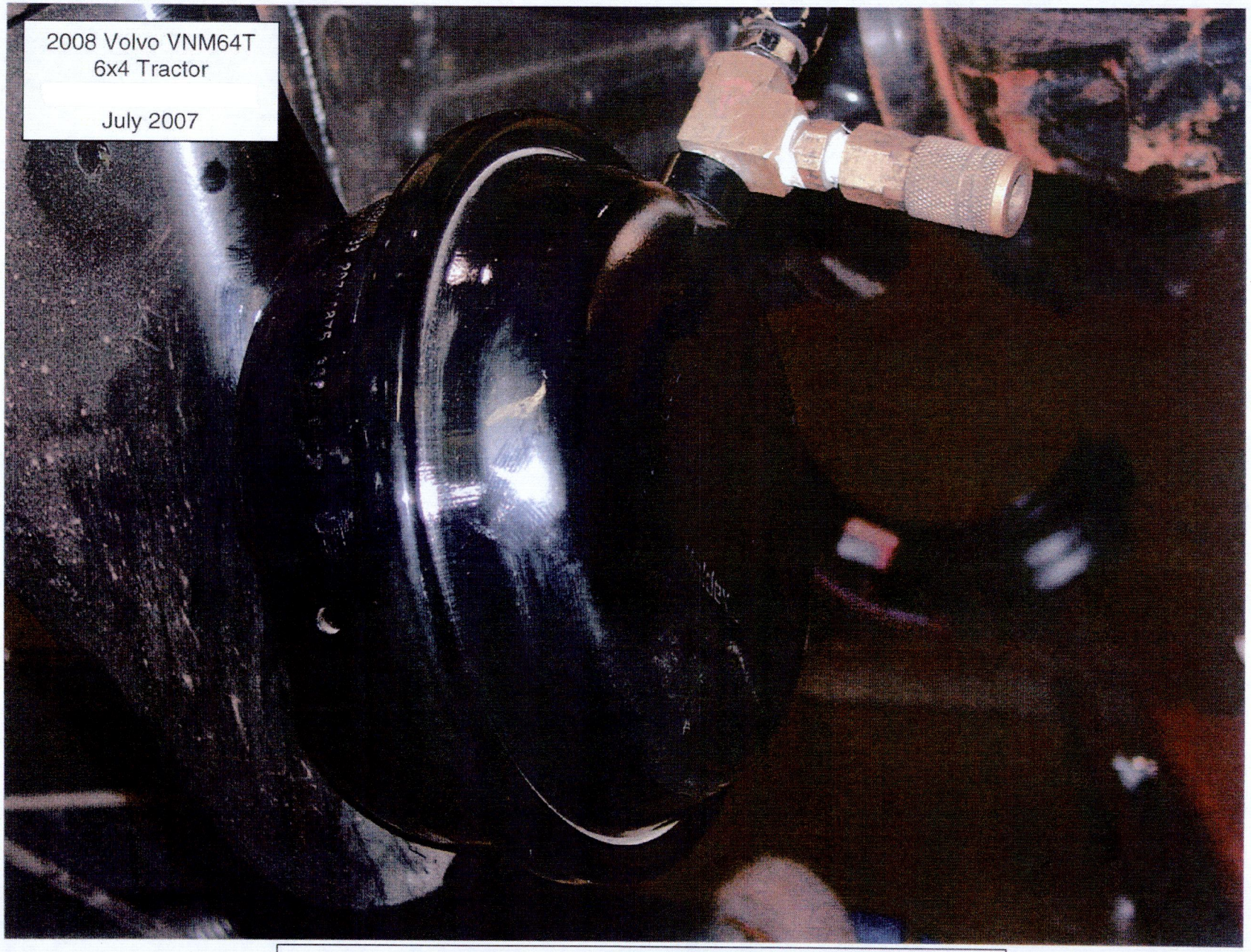
Right Intermediate Slack Adjuster



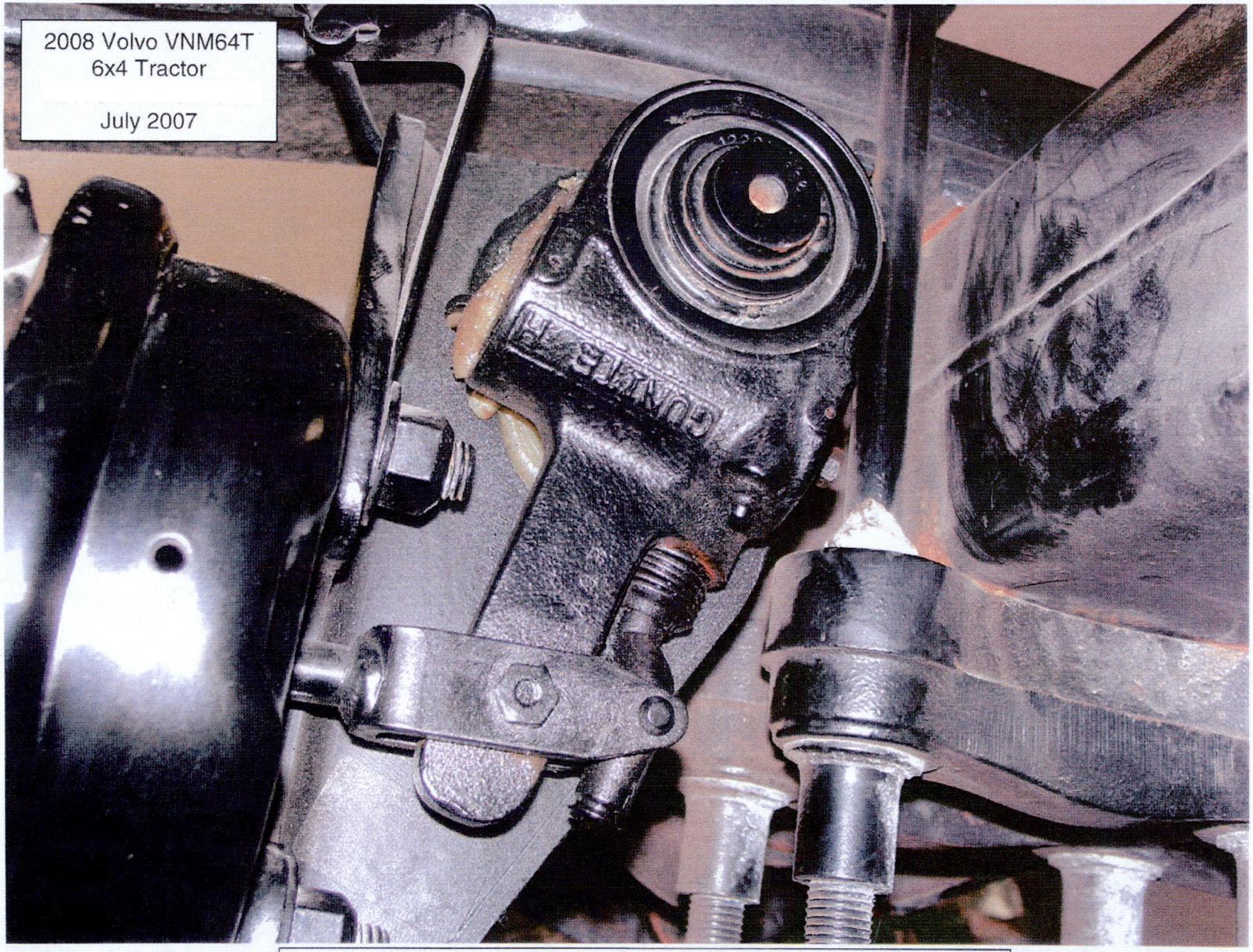
Right Intermediate Thermocouple Installation



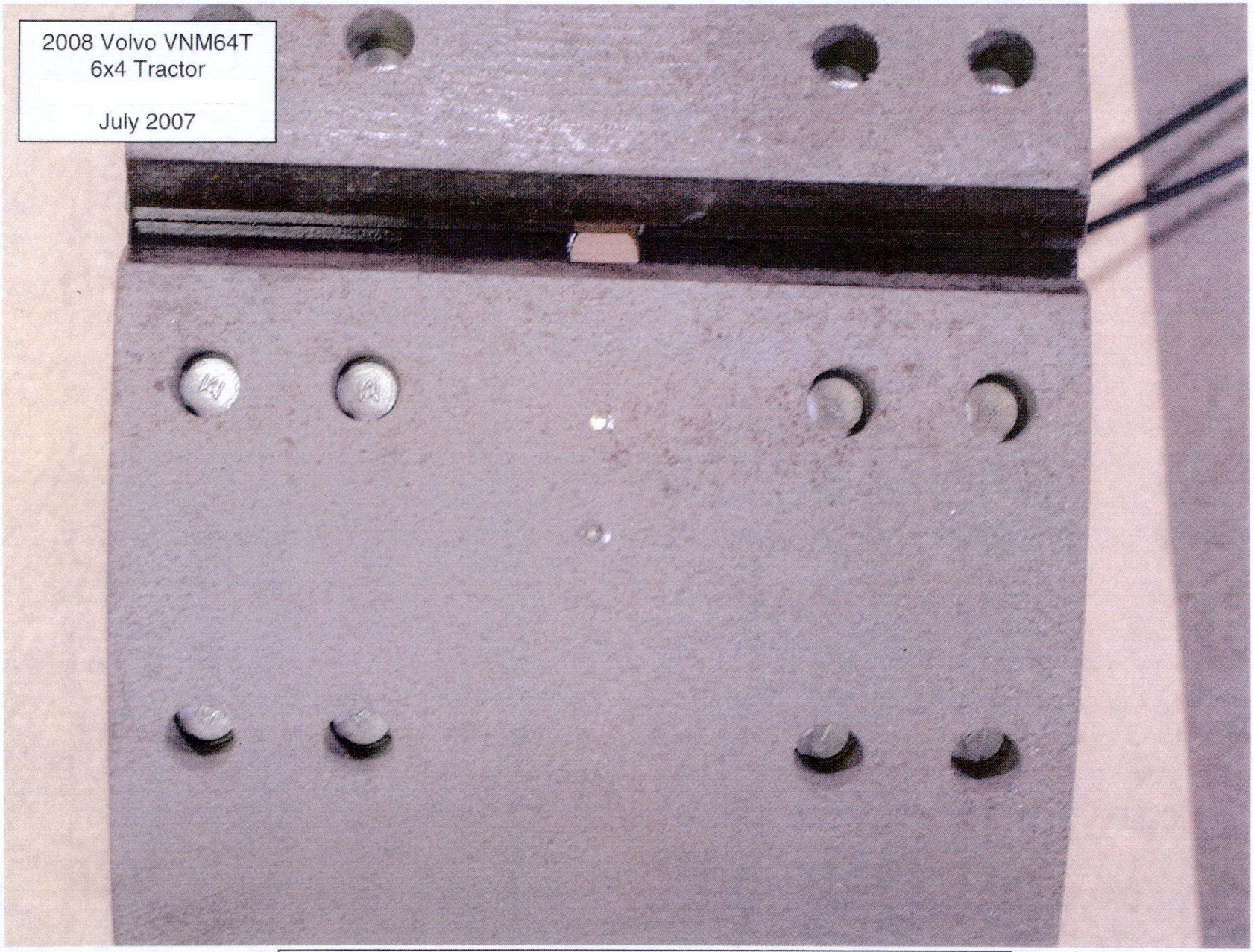
Right Rear Brake Assembly



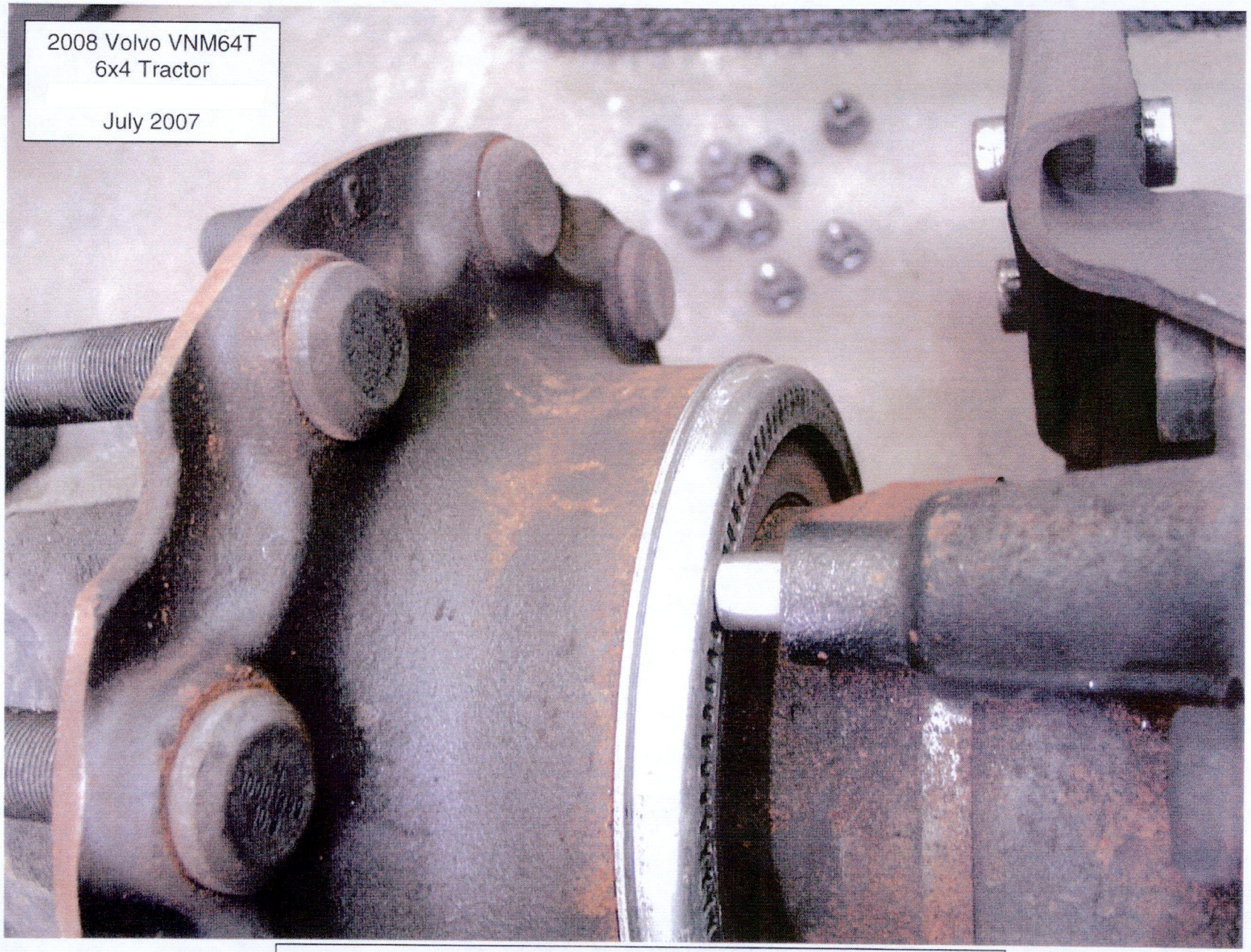
Right Rear Brake Chamber



Right Rear Brake Slack Adjuster



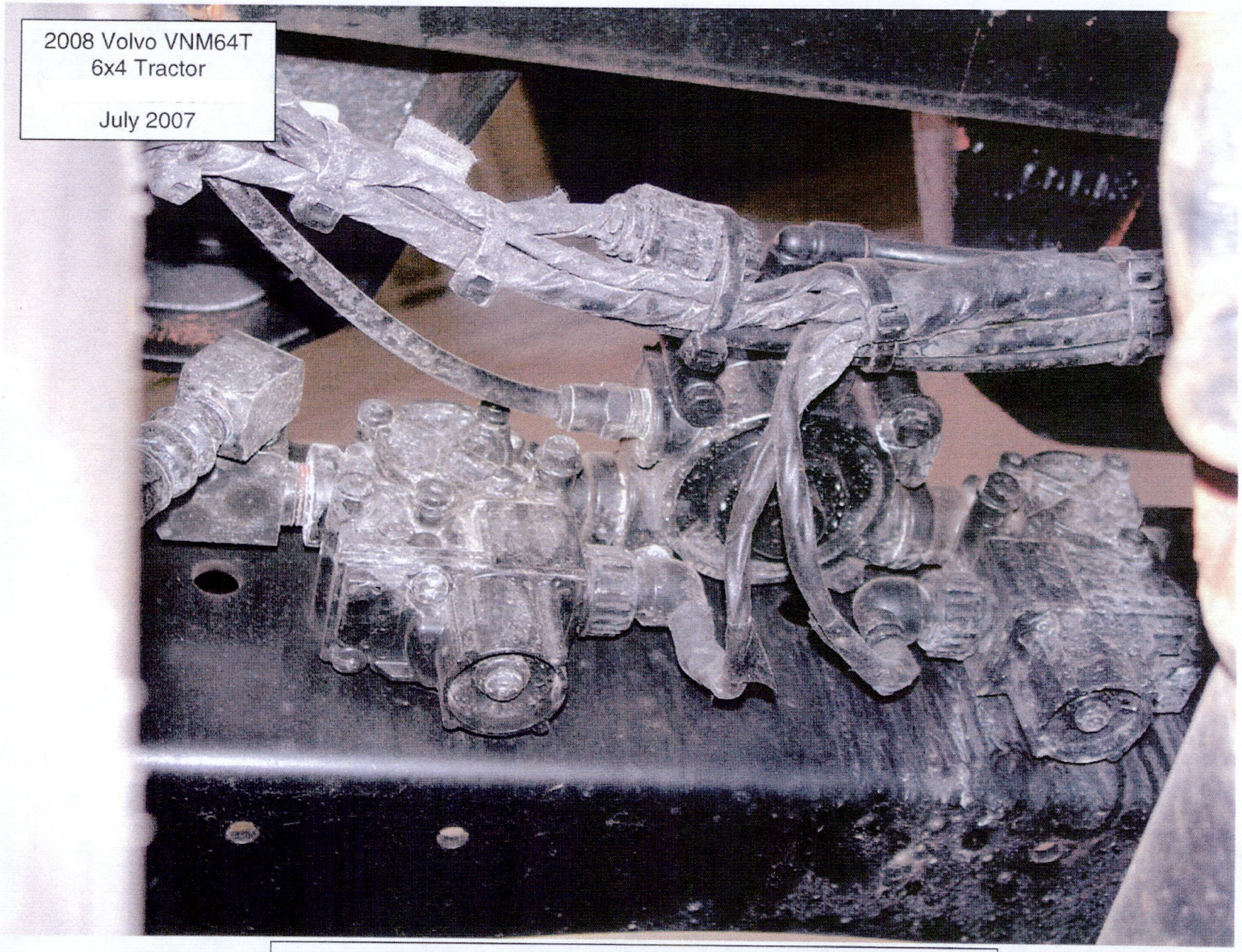
Right Rear Brake Thermocouple Installation



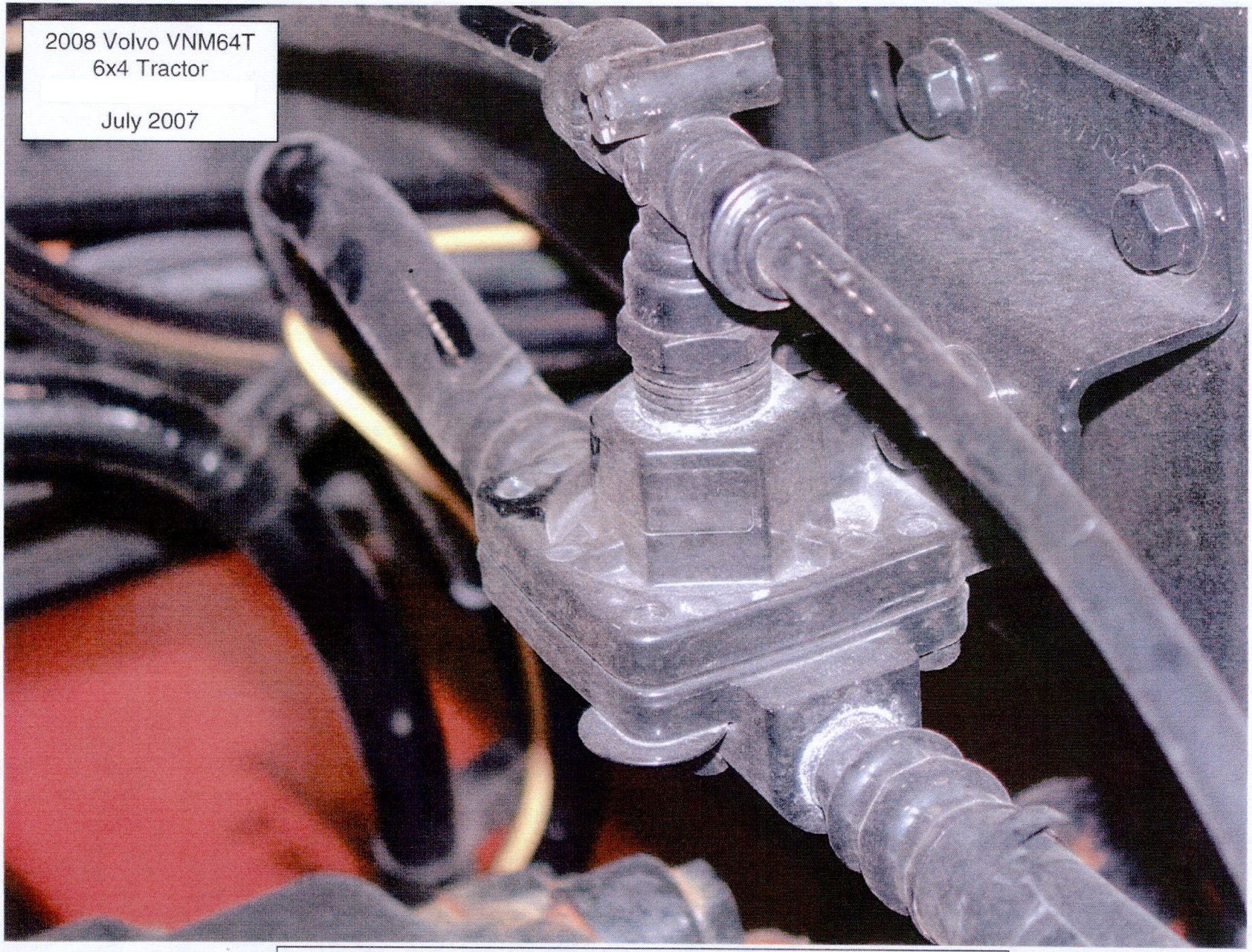
Right Rear Brake Wheel Speed Sensor

2008 Volvo VNM64T
6x4 Tractor

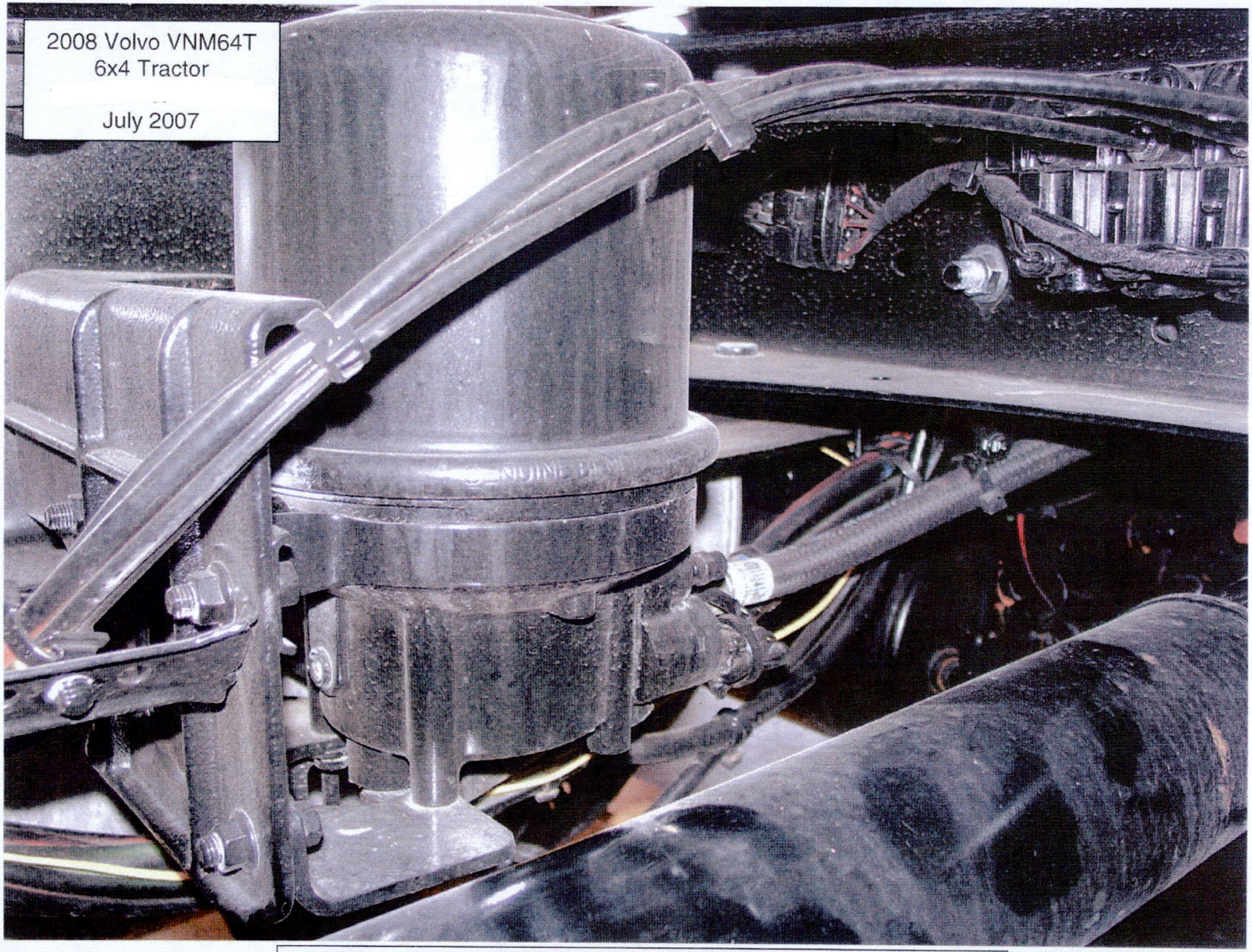
July 2007



Rear Brake ABS Modulator Valves and R12 Valve

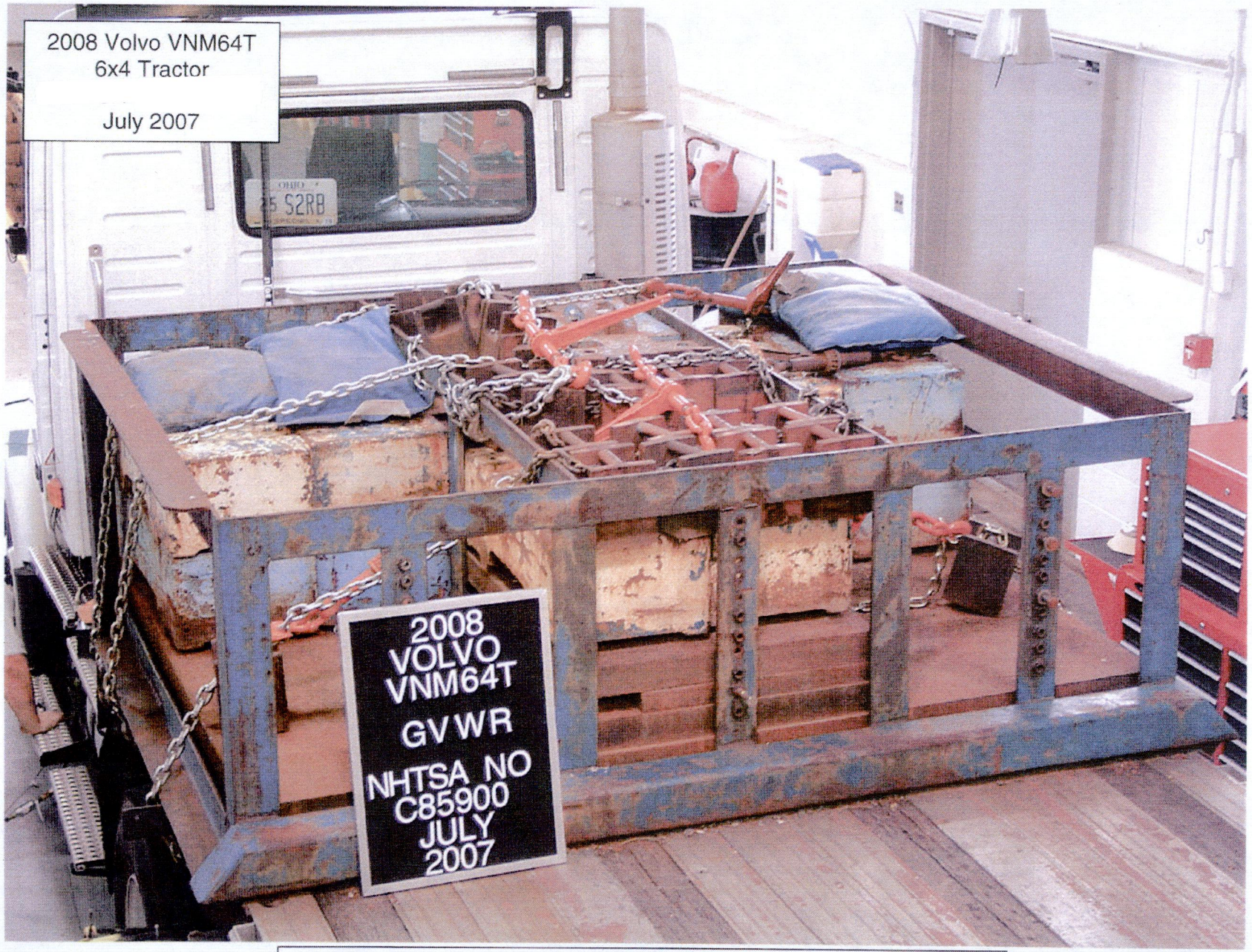


Rear Brake Quick Release Valve



Brake System Air Dryer

Instrumentation in Vehicle



Ballast on Vehicle

2008 Volvo VNM64T
6x4 Tractor

July 2007

Ballast in Vehicle

Dash Warning Lamps

APPENDIX B

TEST DATA FROM REPORT GENERATOR

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/11/07

DATA SHEET 10 - BURNISH AT GVWR

Testing Conditions: INV DATA, Section 0030, 07/11/07, 11:46:35

Weather Conditions: 78°F Wind: 1 mph 65°

Start Odo.: 85 End Odo.: 609

Schedule:
Initial Brake Temperature Less Than 200°F
Initial Speed 40 mph to 20 mph
500 snubs with transmission in gear

Performance Requirements:
Interval between runs: Time necessary to reach speed of 40 mph and 1 mile, or 1.5 miles, whichever occurs first.
Constant decel rate: 10 ft/sec^2
Pedal force adjusted to maintain constant decel.
No Lock-Up allowed longer than 0.1 sec above 10 mph
Vehicle Must stay in lane of 12 ft.

SNUB #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LEFT INTER IBT (°F)	RIGHT INTER IBT (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (%)	AVG. TREADLE PRESSURE (psi)	AVG. DECEL (ft/sec^2)
1	39.23	133	152	152	154	139	130	52.05	8.92
25	40.70	266	299	317	280	300	323	58.82	7.68
50	40.57	267	361	405	310	370	412	56.25	8.77
75	40.34	248	339	370	285	358	385	59.76	9.73
100	40.80	270	366	399	309	384	417	56.25	9.50
125	40.60	282	379	408	317	395	425	63.53	10.17
150	39.83	252	296	305	279	320	322	48.76	10.74
175	40.09	262	333	349	287	353	369	46.98	10.17
200	40.24	269	345	361	293	362	388	49.25	10.34
225	40.09	265	318	326	291	342	347	43.64	10.10
250	40.40	272	340	353	296	363	378	45.33	10.07
275	40.49	261	308	299	284	324	321	52.76	9.45
300	39.76	271	340	351	292	364	376	58.24	10.08
325	40.30	269	319	317	288	340	347	47.29	8.90
350	39.91	280	349	357	301	371	390	54.54	9.98
375	40.43	269	316	314	286	339	341	56.14	10.45
400	40.38	279	324	320	298	348	351	53.06	10.04
425	40.12	265	318	306	276	338	336	39.69	9.81
450	40.34	277	349	352	289	374	396	41.62	10.12
475	39.71	275	346	351	284	378	395	40.42	10.09
500	39.83	284	357	366	292	392	410	40.78	10.48

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/20/07

DATA SHEET 11 - STABILITY AND CONTROL AT GVWR

Testing Conditions: INV DATA, Section 0035, 07/20/07, 09:45:46

Weather Conditions: 62°F Wind: 6 mph 338° Start Odo.: 637 End Odo.: 642

Schedule:
Initial Brake Temperature <200 F
Initial Speed <=40 mph
4 stops with transmission in neutral

Performance Requirements:
Three Stops with:
Highest possible constant speed at which vehicle can be driven through 200 feet of arc of low Mu 500 ft radius curve.
Vehicle Must stay in lane of 12 feet

STOP #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LTAG AXLE IBT (°F)	RTAG AXLE IBT (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	ACTUAL DISTANCE (feet)	CORRECTED DISTANCE (SAE 299) (feet)	MAX. PEDAL PRESSURE (psi)	AVG. PEDAL PRESSURE (psi)	MAX. DECEL (ft/sec²)	AVG. DECEL (ft/sec²)
1	26.31	159	180	176	150	213	184	104.0	103.5	102.25	89.35	22.27	7.50
2	26.26	163	184	176	158	204	183	109.4	109.4	111.19	95.98	21.78	7.24
3	26.31	165	182	176	163	182	176	111.1	110.6	112.33	99.91	22.90	8.07
4	27.19	165	182	176	162	175	177	118.7	110.6	113.43	98.10	25.04	7.44

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)		
1	- NOX	EAST	YES
2	- NOX	EAST	YES
3	- NOX	EAST	YES
4	- NOX	EAST	YES

Corrected Distances are used to determine shortest stopping distance.

COMMENTS: MAXIMUM DRIVE-THROUGH SPEED = 35 MPH
TARGET SPEED IS 75% OF 35 MPH = 26.25 MPH

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/20/07

DATA SHEET 11A - STABILITY AND CONTROL AT LLVW

Testing Conditions: INV DATA, Section 0040, 07/20/07, 10:38:30

Weather Conditions: 65°F Wind: 7 mph 348° Start Odo.: 644 End Odo.: 648

Schedule:
Initial Brake Temperature <200 F
Initial Speed <=40 mph LLVW
4 stops with transmission in neutral

Performance Requirements:
Three Stops with:
Highest possible constant speed at which vehicle can be driven through 200 feet of arc of low Mu 500 ft radius curve.
Vehicle Must stay in lane of 12 feet

STOP #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	ACTUAL DISTANCE (feet)	CORRECTED DISTANCE (SAE 299) (feet)	MAX. TREADLE PRESSURE (psi)	AVG. TREADLE PRESSURE (psi)	MAX. DECEL (ft/sec²)	AVG. DECEL (ft/sec²)
1	28.32	117	144	143	117	117.0	118.4	117.69	107.70	23.04	8.39
2	28.21	121	139	140	123	120.2	122.7	121.19	111.36	24.87	8.73
3	27.21	124	132	134	126	115.4	126.6	121.60	110.59	24.43	7.77
4	28.44	141	154	157	143	124.9	125.4	112.39	103.21	24.56	8.48

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)		
1	- NOX	EAST	YES
2	- NOX	EAST	YES
3	- NOX	EAST	YES
4	- NOX	EAST	YES

Corrected Distances are used to determine shortest stopping distance.

COMMENTS: MAXIMUM DRIVE THROUGH SPEED = 38 MPH
TARGET SPEED IS 75% OF 32 MPH = 28.5 MPH.

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laborstory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/20/07

DATA SHEET 12 - SERVICE BRAKE STOPPING DISTANCE AT GVWR

Testing Conditions: INV DATA, Section 0045, 07/20/07, 12:50:18

Weather Conditions: 70°F Wind: 11 mph 333° Start Odo: 651 End Odo: 669

Schedule:
Initial Brake Temperature: <200°F
Initial Speed: 60 mph, or, if unattainable, a speed multiple of 5.
6 stops with transmission in neutral

Performance Requirements:
One Stop with:
Stopping Distance less than: 355.0 feet
(See Table 1 of FMVSS121, "Stopping Distance Requirements")
Lock-Up allowed no longer than 1 sec above 20 mph on 1 wheel
Vehicle Must stay in lane of 12 ft.

STOP #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LTAG AXLE IBT (°F)	RTAG AXLE IBT (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	ACTUAL DISTANCE (feet)	CORRECTED DISTANCE (SAE J99) (feet)	MAX. TREADLE PRESSURE (psi)	AVG. TREADLE PRESSURE (psi)	MAX. DECEL (ft/sec²)	AVG. DECEL (ft/sec²)
1	60.23	121	129	132	119	137	133	294.5	292.2	117.25	105.89	24.49	13.20
2	60.14	160	163	168	161	171	164	94.9	94.4	109.78	96.09	25.29	13.83
3	60.33	168	189	192	166	195	190	308.1	304.7	110.76	89.31	24.54	11.78
4	59.75	154	187	193	154	191	195	287.5	289.9	113.66	50.15	24.43	7.19
5	60.29	152	185	197	153	190	200	280.6	278.0	114.19	98.57	27.38	12.34
6	20.14	155	184	196	155	190	199	32.5	32.1	111.69	99.43	24.66	9.75

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

COMMENTS: STOP #2 DISTANCE DATA N/G - DAQ PROBLEM.

DATA SHEETS 13,14,15 NOT REQUIRED FOR THIS VEHICLE TYPE - NOT INCLUDED

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C859D0
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/23/07

DATA SHEET 16 - PARKING BRAKE TEST (GRADE HOLDING) AT GVWR

Testing Conditions: INV DATA, Section 0065, 07/23/07, 13:34:21
Parking brake: N/A Non-service type: N/A Service type: N/A

Weather Conditions: 74°F Wind: 3 mph 11° Start Odo.: 748 End Odo.: 748

Test Weight: 53750 lbs Front:11910lbs Rear: 41840 lbs

Schedule:
Initial Brake Temperature <200°F or (Ambient temp. if non-service brake type materials)
loaded to GVWR with transmission in neutral
Drive onto 20% slope in forward and reverse directions.

Performance Requirements:
Up to Three Applies in each direction:
Parking brake must hold the vehicle stationary in both directions for 5 minutes each.

NOTE: For vehicles with parking brake systems not utilizing the service brake friction elements, the friction elements of such systems are to be burnished prior to parking brake tests according to the manufacturer's published recommendation as furnished to the purchaser. If no recommendations are furnished, test the system in an unburnished condition. If recommendations are furnished, record method used.

APPLY #	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	AVG REAR IBT (°F)	DRIVER VEHICLE STOP COMMENTS (Direction of Stop (Up/Down) - Brake holds/fails)			
1	172	159	165.5	- FULL MOVEMENT	UPHILL	NO HOLD	20%
2	166	157	161.5	- FULL MOVEMENT	DOWNHILL	NO HOLD	20%

Is brake system indicator lamp activated: YES (X) NO ( )

COMMENTS: DATA SHEET 17 NOT AVAILABLE.

DATA INDICATES COMPLIANCE: YES ( ) NO (X)

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/24/07

DATA SHEET 18 - SERVICE BRAKE STOPPING DISTANCE AT LLVW

Testing Conditions: INV DATA, Section 0046, 07/24/07, 13:02:27

Weather Conditions: 72°F Wind: 6 mph 71° Start Odo: 765 End Odo: 776

Schedule:
Initial Brake Temperature: <200°F
Initial Speed: 60 mph, or, if unattainable, a speed multiple of 5.
6 stops with transmission in gear

Performance Requirements:
One Stop with:
Stopping Distance less than: 335.0 feet
(See Table 1 of FMVSS121, "Stopping Distance Requirements")
Lock-Up allowed no longer than 1 sec above 20 mph on 1 wheel
Vehicle Must stay in lane of 12 ft.

STOP #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LTAG AXLE IBT (°F)	RTAG AXLE IBT (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	ACTUAL DISTANCE (feet)	CORRECTED DISTANCE (SAE 299) (feet)	MAX. TREADLE PRESSURE (psi)	AVG. TREADLE PRESSURE (psi)	MAX. DECEL (ft/sec²)	AVG. DECEL (ft/sec²)
1	61.16	122	152	145	119	146	150	209.4	201.6	116.96	104.49	38.40	17.19
2	60.00	168	157	151	169	155	159	207.7	207.7	111.49	99.07	39.77	18.03
3	59.46	195	155	150	195	150	155	203.0	206.7	117.77	96.51	37.76	17.53
4	59.70	193	142	143	195	139	148	195.7	197.6	114.91	100.39	40.68	18.02
5	59.90	194	138	141	200	136	146	198.9	199.6	114.56	100.76	39.16	17.77
6	20.11	192	131	136	199	130	140	25.9	25.6	109.90	100.02	40.99	14.47

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)		
1	-	NOX	SOUTH YES
2	-	NOX	SOUTH YES
3	-	NOX	SOUTH YES
4	-	NOX	SOUTH YES
5	-	NOX	SOUTH YES
6	-	NOX	SOUTH YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/24/07

DATA SHEET 19 - EMERGENCY BRAKE STOPPING DISTANCE AT LLVW
Primary Reservior Failure

Testing Conditions: INV DATA, Section 0053, 07/24/07, 13:44:03

Weather Conditions: 73°F Wind: 5 mph 77° Start Odo: 776 End Odo: 791

Schedule:
Initial Brake Temperature: <200°F
Initial Speed: 60 mph, or, if unattainable, a speed multiple of 5.
6 stops with transmission in gear

Performance Requirements:
One Stop with:
Stopping Distance less than: 720.0 feet
(See Table 1 of FMVSS121, "Stopping Distance Requirements")
Lock-Up allowed no longer than 1 sec above 20 mph on 1 wheel
Vehicle Must stay in lane of 12 ft.

STOP #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LTAG AXLE IBT (°F)	RTAG AXLE IBT (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	ACTUAL DISTANCE (feet)	CORRECTED DISTANCE (SAE 299) (feet)	MAX. TREADLE PRESSURE (psi)	AVG. TREADLE PRESSURE (psi)	MAX. DECEL (ft/sec²)	AVG. DECEL (ft/sec²)
1	59.51	172	127	133	177	126	137	192.2	195.4	49.15	37.17	37.99	18.55
2	60.30	190	129	133	195	125	135	202.8	200.8	47.85	35.99	32.79	17.38
3	60.50	197	125	131	203	125	138	207.7	204.3	48.23	36.74	31.95	18.42
4	58.95	190	122	130	195	123	133	194.0	201.0	47.84	36.03	39.78	18.73
5	59.90	193	123	128	203	123	134	203.9	204.6	48.79	36.46	36.20	18.55
6	19.96	193	120	128	198	119	134	24.9	25.0	46.70	39.36	32.05	12.77

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/24/07

DATA SHEET 20 - EMERGENCY BRAKE SECONDARY STOPPING DISTANCE AT LLVW
Secondary Reservior Failure

Testing Conditions: INV DATA, Section 0054, 07/24/07, 14:32:21

Weather Conditions: 74°F Wind: 2 mph 55° Start Odo: 791 End Odo: 805

Schedule:
Initial Brake Temperature: <200°F
Initial Speed: 60 mph, or, if unattainable, a speed multiple of 5.
6 stops with transmission in gear

Performance Requirements:
One Stop with:
Stopping Distance less than: 720.0 feet
(See Table 1 of FMVSS121, "Stopping Distance Requirements")
Lock-Up allowed no longer than 1 sec above 20 mph on 1 wheel
Vehicle Must stay in lane of 12 ft.

STOP #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LTAG AXLE IBT (°F)	RTAG AXLE (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	ACTUAL DISTANCE (feet)	CORRECTED DISTANCE (SAE 299) (feet)	MAX. TREADLE PRESSURE (psi)	AVG. TREADLE PRESSURE (psi)	MAX. DECEL (ft/sec²)	AVG. DECEL (ft/sec²)
1	60.68	164	113	121	166	110	123	285.8	279.5	111.85	92.94	28.53	13.72
2	60.03	177	128	136	182	124	138	283.0	282.6	109.04	89.73	31.71	13.69
3	60.52	183	137	141	189	131	146	280.8	276.0	108.85	89.48	30.34	13.56
4	60.03	189	144	150	197	139	152	287.7	287.4	108.77	88.76	29.35	13.20
5	60.81	193	148	158	200	145	159	282.8	275.3	102.14	85.69	31.91	13.76
6	19.54	187	148	155	192	137	162	33.1	34.7	101.89	90.53	26.47	11.01

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)		
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/24/07

DATA SHEET 21 - EMERGENCY BRAKE CONTROL LINE FAILURE DISTANCE @LLVW
Control Line Failure (Continued)

Testing Conditions: INV DATA, Section 0055, 07/24/07, 15:49:20

Weather Conditions: 74°F Wind: 5 mph 26° Start Odo: 808 End Odo: 828

Schedule:
Initial Brake Temperature: <200°F
Initial Speed: 60 mph, or, if unattainable, a speed multiple of 5.
6 stops with transmission in gear

Performance Requirements:
One Stop with:
Stopping Distance less than: 720.0 feet
(See Table 1 of FMVSS121, "Stopping Distance Requirements")
Lock-Up allowed no longer than 1 sec above 20 mph on 1 wheel
Vehicle Must stay in lane of 12 ft.

STOP #	INIT SPD (mph)	LEFT FRONT IBT (°F)	RIGHT FRONT IBT (°F)	LTAG AXLE IBT (°F)	RTAG AXLE IBT (°F)	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	ACTUAL DISTANCE (feet)	CORRECTED DISTANCE (SAE 299) (feet)	MAX. TREADLE PRESSURE (psi)	AVG. TREADLE PRESSURE (psi)	MAX. DECEL (ft/sec²)	AVG. DECEL (ft/sec²)
1	58.46	143	154	154	146	148	158	242.1	255.0	100.98	85.48	25.75	13.56
2	59.39	192	148	149	195	140	151	257.8	263.1	99.82	85.20	26.34	13.60
3	61.59	181	125	132	185	124	133	245.9	233.4	101.85	83.25	28.80	14.54
4	60.63	194	119	123	196	117	126	273.1	267.4	96.56	83.49	28.94	13.19
5	59.98	196	111	118	200	113	119	258.2	258.4	99.85	80.75	25.50	13.88
6	20.09	181	106	113	187	108	113	32.5	32.2	97.16	89.60	23.68	10.74

STOP #	DRIVER VEHICLE STOP COMMENTS (Wheel Lock up - Direction of Stop - Stay in Lane)		
1	-	NOX	SOUTH YES
2	-	NOX	SOUTH YES
3	-	NOX	SOUTH YES
4	-	NOX	SOUTH YES
5	-	NOX	SOUTH YES
6	-	NOX	SOUTH YES

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

Vehicle: 2008 VOLVO TRUCKS N.A. NHTSA NUMBER: C85900
Make: VOLVO
Model: VNM64T
Body Style: DAYCAB
Front Cold Tire Pressure: 105 (psi)
Rear Cold Tire Pressure: 105 (psi)

Transportation Research Center, Inc.
10820 State Route 347
East Liberty, Ohio 43319

Date Tested: 07/24/07

DATA SHEET 22 - PARKING BRAKE TEST (GRADE HOLDING) AT LLVW

Testing Conditions: INV DATA, Section 0066, 07/24/07, 16:54:39
Parking brake: N/A Non-service type: N/A Service type: N/A

Weather Conditions: 75°F Wind: 6 mph 339° Start Odo.: 828 End Odo.: 828

Test Weight: Total:166401bs Front: 93601bs Rear: 72801bs

Schedule:
Initial Brake Temperature <200°F or (Ambient temp. if non-service brake type materials)
Loaded to GVWR with transmission in neutral
Drive onto 20% slope in forward and reverse directions.

Performance Requirements:
Up to Three Applies in each direction:
Parking brake must hold the vehicle stationary in both directions for 5 minutes each.

NOTE: For vehicles with parking brake systems not utilizing the service brake friction elements, the friction elements of such systems are to be burnished prior to parking brake tests according to the manufacturer's published recommendation as furnished to the purchaser. If no recommendations are furnished, test the system in an unburnished condition. If recommendations are furnished, record method used.

APPLY #	LEFT REAR IBT (°F)	RIGHT REAR IBT (°F)	AVG REAR IBT (°F)		DRIVER VEHICLE STOP COMMENTS (Direction of Stop (Up/Down) - Brake holds/fails)			
1	143	187	165.0	-	NO MOVEMENT	UPHILL	HOLDS	20%
2	136	172	154.0	-	NO MOVEMENT	DOWNHILL	HOLDS	20%

Is brake system indicator lamp activated: YES (X) NO ( )

DATA INDICATES COMPLIANCE: YES (X) NO ( )

Driver: RICHARD HEBERLI Observer: NONE
Recorded Data Processed by: CHUCK JENKINS Date: 08/13/07
Approving Laboratory Official: RANDALL LANDES Date: 08/27/07

APPENDIX C

ENGINEER'S TEST COMMENTS

For Data Sheets 11 and 11A, "Apply Time" is the time from the first movement of the service brake control until the service brake control line pressure reaches 85 psi. (Note: Accelerometer affixed to the service brake control to detect first movement.)

For Data Sheet 17, Parking Brake Test – Drawbar Pull, during the third rearward pull (180 to 270 degrees), there was a momentary failure of the data acquisition system causing an incomplete data file. From the data obtained, regarding the other three rearward pulls, it would be likely this portion of the pull test would also comply.

Per OVSC and as an indicant test, a 20 mph stop was performed at the end of each stop sequence.